

The NASA logo, featuring the word "NASA" in a stylized font with a red chevron above it.

National Aeronautics and
Space Administration

Educational Services

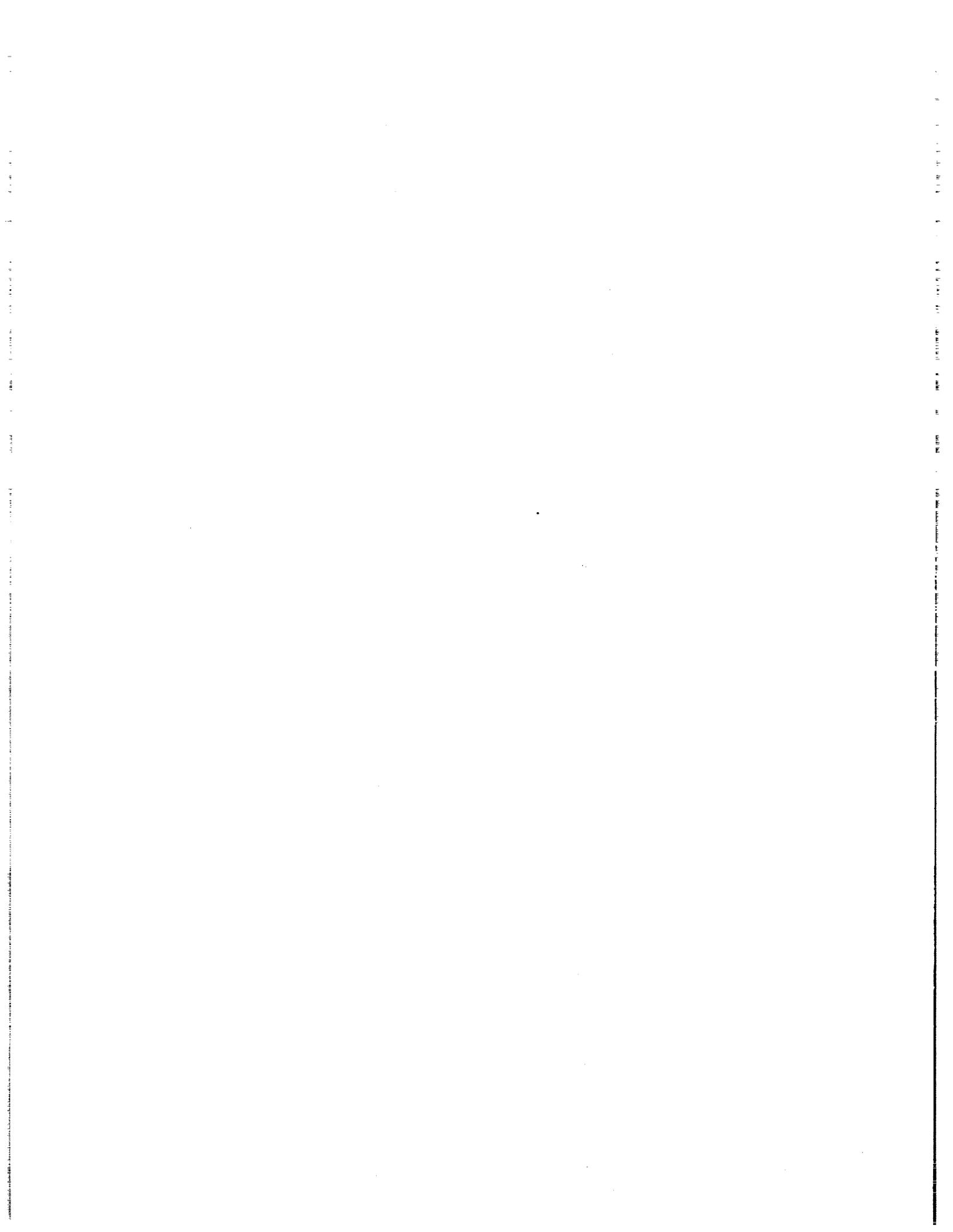
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Grades K-University

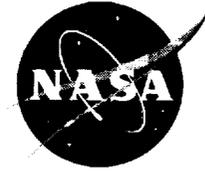


NASA's Earth Science Enterprise

1998
Education
Catalog



National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



Reply to Attn of: Y

FEB 24 1998

Dear Colleague:

NASA's Earth Science Enterprise is at the forefront of the international scientific endeavor to understand our changing planet. As such, it is also at the forefront of the Agency's education efforts. Not only a source of the latest scientific understanding of the Earth, our research missions provide many exciting educational applications and resources. We are very proud to describe our Earth Science education programs and products in this catalog.

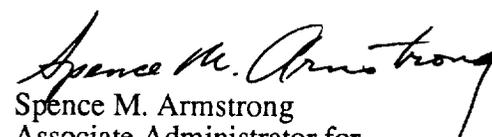
NASA's Earth science education programs are far-reaching and diverse. Student support ranges from hands-on experiences for elementary and secondary school students, to undergraduate and graduate level research and working experiences at U.S. universities and NASA Field Centers. Systemic change efforts aim to incorporate Earth system science content into state and local education systems. Curriculum support activities are developing the materials and resources necessary for using NASA Earth science content in the classroom. Teacher/faculty preparation and enhancement includes college courses and professional development workshops. Our programs reach out to educators and students in every state and at all education levels.

NASA has also produced a robust set of Earth science education products. These resources include simple, but very effective, classroom activity guides; colorful posters, slides, and lithographs of Earth satellite imagery and science processes; inspiring videos; powerful CD-ROMs; and interactive World Wide Web sites. We invite you to explore these rich group of materials as a source for your educational endeavors.

This catalog is published and updated periodically as a reference guide to NASA Earth science education programs and products. We hope you will find it informative and useful in developing your education and research program in the Earth Sciences.

Sincerely,


Ghassem R. Asrar
Associate Administrator for
Earth Science


Spence M. Armstrong
Associate Administrator for
Human Resources and Education



**NASA's Earth
Science Enterprise**

1998 Education Catalog

Office of Earth Science

Office of Human Resources and Education

National Aeronautics and Space Administration

Washington, DC
January 1998

NASA's Earth Science Enterprise

1998 Education Catalog

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INTRODUCTION

NASA's Earth Science Enterprise

Since its creation in 1958, the National Aeronautics and Space Administration (NASA) has been studying the Earth and its changing environment by observing the atmosphere, oceans, land, ice, and snow, and their influence on climate and weather. We now understand that the key to gaining a better understanding of the global environment is by exploring how the Earth's systems of air, land, water, and life interact with each other. This approach — called Earth system science — blends together fields such as meteorology, oceanography, biology, and atmospheric science.

The Earth Science Enterprise (ESE)* is pioneering the emerging discipline of Earth system science, with a near-term emphasis on global climate change. NASA is working in concert with other U.S. and international organizations, using satellites and other tools to intensively study the Earth in order to substantially improve our understanding of how natural processes affect us, and how we might be affecting them. Such studies will yield improved weather forecasts, tools for managing agriculture and forests, information for fisherman and local planners, and, eventually, the ability to predict how climate will change in the future.

ESE has three main components: a series of Earth-observing satellites, an advanced data system, and teams of scientists who are studying the data.

Key areas of study are:

- Land-Cover/Land-Use Change Research;
- Seasonal-to-Interannual Climate Variability and Prediction;
- Natural Hazards Research and Applications;
- Long-Term Climate: Natural Variability and Change Research;
- Atmospheric Ozone Research

Today's program is laying the foundation for long-term environmental and climate monitoring and prediction. Potentially, this will provide the understanding needed in the future to support difficult decisions regarding the Earth's environment.

Education — A Key Goal

The goals of NASA's ESE are to expand scientific knowledge of the Earth system using NASA's unique vantage points of space, aircraft, and in situ platforms, creating an international capability to forecast and assess the health of the Earth system; to widely disseminate information about the Earth system; and to enable the productive use of Earth science results and related technology in the public and private sector. The education community is a key customer.

ESE supports a variety of education activities developed in partnership with the NASA Headquarters Education Division, and carried out through NASA Field

Centers, universities, and other organizations. These activities are at all education levels, including:

- Student support, including research opportunities, fellowships, brief courses, and summer workshops
- Teacher and faculty preparation and enrichment, including training workshops, courses, and research positions at NASA Centers
- Systemic change, which aims to infuse Earth system science content into state curricula and education systems; and
- Curriculum support, including developing education products and model curricula.

ESE produces a wide variety of education products for teachers and students. Lithographs, teachers' guides with classroom activities, posters, Internet sites, videotapes, CD-ROMs, and slide sets all make NASA data and information available to classrooms across the country. Teachers and students are involved in the development of these products, from initial concept definition through testing and evaluation.

NASA's Earth Science Enterprise, 1998 Education Catalog provides information about Agency-wide Earth science education programs and resources for elementary through university levels.

**ESE was formerly known as Mission to Planet Earth (MTPE)*

Student Support

Student support includes enrichment activities, such as brief courses, summer workshops, and hands-on science education experiences, which expose students to Earth system science subjects and processes. It also includes research opportunities through programs that provide direct financial assistance and fellowships, as well as research and training at NASA facilities and universities. These programs are providing opportunities for students at all education levels to develop new skills, gain experience working with researchers, and to learn first-hand about Earth system science careers and research.

Elementary and Secondary

Ames Aerospace Encounter

<http://ccf.arc.nasa.gov/dx/encounte.html>

NASA Ames Research Center hosts fourth, fifth, and six grade classes in an interactive, hands-on program, entitled the Ames Aerospace Encounter. Located in a renovated supersonic wind tunnel, the Aerospace Encounter involves students in activities focused around four topics: aeronautics, space science, living and working in space, and Earth system science. Students experiment with a table-top wind tunnel, examine planetary probes, and simulate a mission aboard a space station.

The Earth system science tutorial features color, sound, animation, and images of Earth taken from aircraft and satellites. Using a mouse to point and click buttons on the computer screen, students learn about remote sensing, light, color, and geography. Using remotely-sensed images, the students attempt to find their way to Moffett Field, California by clicking on specific geographic features, and identifying North America, California, the San Francisco Bay area, and finally the runway on Moffett Field at NASA Ames Research Center. This strategy helps students learn to recognize geographic features across many scales and become familiar with remote-sensing techniques.

The Ames Aerospace Encounter is free; groups are accepted on a space-available basis for this popular program.

Contact: Ames Aerospace Encounter, Mail Stop 226-1, NASA Ames Research Center, Moffett Field, CA 94035-1000 USA; Phone: (650) 604-4989

Boreal Forest Watch

<http://www.bfw.sr.unh.edu/>

Boreal Forest Watch (BFW) is an educational outreach program for the Boreal Ecosystem-Atmosphere Study (BOREAS). BFW involves 9-12 graders in conducting real research as part of their educational experience. Teachers and students practice the scientific method by participating in an on-going research project. They are able to integrate multidisciplinary skills in a problem-solving approach. All activities within the

program meet or exceed provincial educational standards in science, mathematics, and other fields.

BFW takes place in the boreal ecosystem region of northern Saskatchewan and Manitoba, Canada. Students and teachers from several area schools near Prince Albert, SK and Thompson, MB conduct environmental monitoring studies in the boreal forests which are near their schools. Students set up permanent sampling plots and assess the current condition of this plot. They also collect data such as tree height, diameter, overstory and understory species composition, tree core analysis, land cover mapping and remote sensing activities, and plant anatomical characteristics among many other measurements and activities. These data are collected and archived for future use in ecological monitoring studies of the boreal region as well as in class studies.

Teachers involved with BFW are trained on how to conduct program activities, which includes introduction and training in remote-sensing principles. Intensive BFW training workshops are held periodically, tentative plans are to hold a refresher workshop for current teachers in the Prince Albert area and the Thompson area, during the fall or winter of 1997-1998.

Contact: Shannon Spencer, Complex Systems Research Center, Institute for the Study of Earth, Oceans, and Space, Morse Hall, University of New Hampshire, Durham, NH 03824 USA; Phone: (603) 862-1792; Fax: (603) 862-0188; E-mail: shannon.spencer@unh.edu



Challenger Center for Space Science Education: Encounter Earth

<http://www.challenger.org/>

Using space exploration as a theme, the Challenger Center for Space Science Education was founded to create positive learning experiences, to excite students about exploration, and inspire students to pursue math, science, and technology studies. Challenger Learning Center sites are an international network of 30 high-technology spaceflight simulators for hands-on learning experiences, using a variety of mathematics, science, and problem-solving skills. Annually, about 300,000 students visit Challenger Learning Center sites located across the U.S. and in Canada. Learning Centers conduct on-site missions, provide teacher in-service training, and supply pre- and post-visit curriculum kits.

Through funding from the National Science Foundation and technical support from NASA, the Challenger Center for Space Science Education developed *Encounter Earth*. In this scenario, set in the summer of the year 2137, a low Earth-orbiting satellite has malfunctioned and must be replaced. The elite Emergency Response Squad, ERS-1, has been called in to construct a new satellite, deploy the satellite, and retrieve important data about the Earth and its environment. Students collect data, avert disasters on Earth, and

learn about the intricate relationships of Earth's atmosphere, hydrosphere, biosphere, ecosphere, and geosphere.

Fee varies by site, groups are accepted on a space-available basis.

Contact: Challenger Center for Space Science Education, 1029 North Royal Street, Suite 300, Alexandria, VA 22314 USA; Phone: (703) 683-9740 or 1-800-98-STARs; Fax: (703) 683-7546

EarthKam

<http://www.kidsat.ucsd.edu/>

EarthKam (formerly KidSat) is a NASA-sponsored research and development project which links middle school, high school, and university students to Space Shuttle missions. These students remotely operate a Kodak electronic still camera, mounted in the starboard overhead window of the Space Shuttle, to take digital photographs of the Earth. Middle School students are responsible for planning the photo requests, which involves calculating the longitude and latitude of a region, as well as the exact time the Shuttle flies over it. High School and university students then compile the requests into a single control file which is forwarded, by EarthKam representatives at Johnson Space Center, to the IBM Thinkpad connected to the camera. Using special flight software, also developed by students, the Thinkpad automatically commands the camera to snap the pictures requested by the middle schools. These pictures then retrace their path back down to Earth where they reach their final destination - a computer archive at JPL. Using the Internet, students

can then access their pictures from this archive, in near real-time during the mission.

EarthKam's main objective is to give middle schools the opportunity to observe the Earth from the vantage point of space, and subsequently, conduct active scientific inquiries based upon their observations and classroom studies. Middle school students gain first hand experience with current technology, as well as achieve teaming and problem-solving skills.

EarthKam has been through three Space Shuttle missions, STS-76, -81, and -86, with additional missions planned for 1998. Three U.S. middle schools participated in the first flight. Since then, EarthKam has grown to fifteen schools in STS-81, and over forty schools in STS-86. Over 1,600 photos were taken by the missions, which can be accessed at: <http://www.jpl.nasa.gov/kidsat/datasys>.

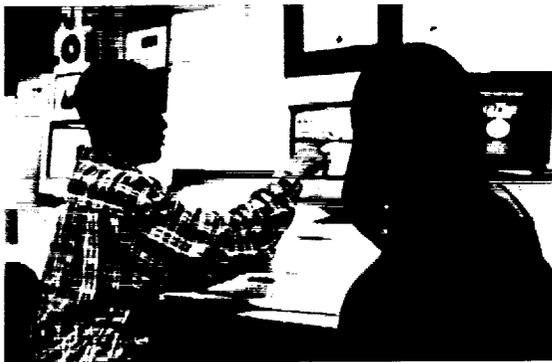
EarthKam is a collaboration among the University of California, San Diego, the Johns Hopkins University Institute for the Academic Advancement of Youth (IAAY); and the Jet Propulsion Laboratory.

Contact: JoBea Way, Jet Propulsion Laboratory, MS 300-233, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; E-mail: way@lor.jpl.nasa.gov

ECSU Earth System Science Academy

<http://nia.ecsu.edu/nrts/essa.html>

Elizabeth City State University (ECSU) is a historically-black institution located in North Carolina. Through its Network Research and Training Site, funded by NASA, ECSU has formed an expert site in Earth System



Science; the Earth System Science Academy is one of its major activities. During the two-day summer Academy, students tour the Great Dismal Swamp - ECSU owns a large portion of the swamp - and interact with teachers and researchers involved in wetlands research. The primary purpose of the property is to provide access to a pristine wetlands environment, and to promote public awareness of the crucial role played by wetlands in the coastal plain biome.

Contact: Linda Bailey Hayden, Box 672, 1704 Weeksville Road, Mathematics and Computer Science Dept., Elizabeth City State University, Elizabeth City, NC 27909 USA; Phone: (919) 335-3617; Fax: (919) 335-3487; E-mail: lhayden@ga.unc.edu

Forest Watch

<http://www.nhsgc.sr.unh.edu/outreach.html>

The University of New Hampshire (UNH) has developed Forest Watch — a New England-wide environmental outreach activity designed to introduce both teachers and their students to field, laboratory, and satellite data analysis methods for assessing the state-of-health of local forest stands. Forest Watch provides workshops which are designed to help K-12 teachers introduce their students to selected hands-on techniques, based on University research methods, for evaluating the health of white pine (*Pinus strobus*), a known bio-indicator for tropospheric or low-level ozone damage. Through Forest Watch, students become actively involved in doing meaningful scientific research, and in the

process, collect and compile data useful to UNH researchers conducting a regional survey of white pine health in New England. Future Forest Watch collection activities will be expanded into New York, Pennsylvania, New Jersey, and Maryland and other areas where white pine occurs.

Beginning in late April, on or around Earth Day (April 22), students participate in three types of activities in Forest Watch, each patterned after activities conducted by professional remote-sensing scientists: 1) forest stand assessment, including selection of local white pine trees for study, 2) laboratory-based assessment of foliar damage symptoms for the selected trees, and 3) image processing/data analysis of Landsat Thematic Mapper (TM) data for the area around their school. Their field and laboratory measurements are sent to the University of New Hampshire, where they are analyzed and integrated into an on-going regional white pine study and each year a compilation of Forest Watch results is published.

Similar environmental education programs currently under development at UNH include Boreal Forest Watch (involving high schools and middle schools in Saskatchewan and Manitoba, Canada) and Czech Forest Watch (involving K-12 schools in the Czech Republic). These programs provide participating Forest Watch students with opportunities to communicate their studies and findings with students in other countries who are conducting similar studies.

Contacts: Dr. Barry Rock (Program Director) or Mr. Gary Lauten (Program

Coordinator), Complex Systems, Research Center, Morse Hall, University of New Hampshire, Durham, NH 03824 USA; Phone: (603) 862-1792; Fax: (603) 862-0188; E-mail: barry.rock@unh.edu or gary.lauten@unh.edu

Global Learning and Observations to Benefit the Environment (GLOBE)

<http://www.globe.gov>

GLOBE is a worldwide network of K-12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. GLOBE environmental measurements are in the following study areas: Atmosphere/Climate; Hydrology/Water Chemistry; and Biology/Geology. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Each day, images created from the GLOBE student data sets are posted on the World Wide Web, allowing students and visitors to the GLOBE web site to visualize the student environmental observations. Teachers and students from over 4,000 schools in over 55 countries currently participate in GLOBE.

An interagency team manages GLOBE, which includes NASA, the National Oceanic and Atmospheric Administration, the National Science Foundation, the Environmental Protection Agency, and the Departments of Education and State.



There is no cost to apply, however schools must provide travel for teachers to attend GLOBE training, equipment for making measurements, computer, and internet connection to the WWW.

Contact Information: GLOBE Program, 744 Jackson Place, Washington, DC 20503 USA; Phone: (800) 858-9947; E-mail: info@globe.gov

Goddard Institute for Space Studies — Institute on Climate and Planets

<http://icp.giss.nasa.gov/>

The Institute on Climate and Planets (ICP) is a collaboration between NASA Goddard Institute for Space Studies (GISS), the City University of New York Alliance for Minority Participation, and the New York City Public Schools, which allows educators and science practitioners to form an ICP Lead and Partner School Research Network. The key goal of the ICP is to create a productive and stimulating year-round learning environment which extends NASA's climate research program from GISS to high school and college classrooms. Participating schools are dedicated to addressing New York State Learning Standards for Mathematics, Science, and Technology (based on the AAAS Project 2061), creating an advanced science learning environment for minority students, and providing them with access to professional and academic networks through which to pursue their interests in scientific discovery.

The intensive summer ICP program held at NASA GISS, and the academic year workshops conducted by faculty at ICP Lead Schools increase the capability of students and teaching faculty to establish satellite research programs on their campuses. The result is varied education-level science teams that engage scientists, educators and students in a sustained, research-driven dialogue. This dialogue can make a significant contribution toward addressing recent calls for national and state science standards. With the support of the NASA Minority University-Space Interdisciplinary Network (MU-SPIN), the school research network is gaining the technical competence and resources needed to contribute to on-going climate research projects. One of the newest venues for this contribution is via the newly-created ICP Web site's Virtual Research Institute. Currently, this network is comprised of six junior and senior colleges and six secondary schools in the New York City area. It is expected that two colleges and three secondary schools will join the network this year.

Communication and public education about the research and education outcomes of the ICP are the collective responsibility of students, faculty, and scientists. Presentations are made annually at professional meetings, academic competitions, local conferences, and in a small number of publications. Students also organize a Saturday Space Quest program for elementary school students, as well as a Paths to Discovery Seminar Series to engage their peers in a dialogue with science leaders about global climate

change. The faculty's main contribution to ICP public education is by developing curriculum motivated by their research and field-testing in core science courses and research classes. Faculty are also working with scientists to develop an Earth Climate curriculum based on their research experiences and projects.

Contact: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025 USA; Phone: (212) 678-5653; Fax: (212) 678-5552; E-mail: charris@giss.nasa.gov

The JASON Project

<http://www.jasonproject.org/>

The JASON Foundation engages students in science and technology, and motivates and provides professional development opportunities for teachers through the use of advanced interactive telecommunications. JASON expeditions, targeted for grades 4-10, are supported by extensive teacher training and award-winning curriculum and feature live, interactive broadcasts through robotics, fiber optics, television production, computer science, and satellite communications. JASON programs are broadcast to Primary Interactive Network Sites (PINS) in 16 states, England, Canada, and Bermuda. NASA PINS include Ames Research Center, Goddard Space Flight Center, and Johnson Space Center. Teachers can also get involved through a new Internet-based program, JASON@SCHOOL. For more information visit the JASON homepage.

Past JASON voyages have included a voyage to investigate life at the edge of a



moving ocean where scientists, students, and teachers will explore conditions for life and the relationships which exist there; an expedition to Hawaii, the world's most isolated spot of land where fantastic adaptation of pioneering species has created a unique biological laboratory; a journey to the rainforests, caverns, Mayan ruins, and coral reef of Belize; diving to the hydrothermal vents in the Sea of Cortez and learning about the gray whales of San Ignacio Lagoon; following the footsteps of Charles Darwin to explore the unique land and marine life of the Galapagos islands on the equator; to Lake Ontario for a comprehensive examination of two warships from the War of 1912; and an expedition to the Mediterranean Sea to explore an ancient Roman shipwreck.

There is no registration fee, however, groups need to register and travel to a Jason PINS site to participate.

Contact: JASON Foundation for Education, 395 Totten Pond Road, Waltham, MA 02154 USA; Phone: (617) 487-9995; Fax: (617) 487-9999; E-mail: info@jason.org

Project SMART

<http://www.nhsgc.sr.unh.edu/psmart>

The New Hampshire Space Grant Consortium (NHSGC) co-sponsors Project SMART (Science and Mathematics Achievement through Research Training), a UNH summer program for 10th and 11th grade students. The program is open on a competitive basis to students from New Hampshire and surrounding states.

Project SMART provides a summer institute at the University of New Hampshire that challenges, educates, and motivates talented high school students in science and mathematics while acquainting them with the environment and resources of the University as a place for higher education and research. Students may choose to apply in one of four areas of science: Biotechnology, Environmental Science, Freshwater and Marine Science, and Space Science. NHSGC faculty lead the Environmental and Space Science modules.

Project SMART exposes students to an enriching experience in science and mathematics while, at the same time, preparing them to be scientifically-literate citizens. Given opportunities to explore careers in science and mathematics, many of these students will continue their education in these disciplines at the pre-college and college level. Students receive an intensive live-in experience where they learn not only about current science developments, but also get a historical and philosophical perspective for understanding the social and ethical issues raised by recent developments. The program offers excitement, information, challenge, hard work and fun, all during the four weeks in July that participants are at UNH. It includes a combination of current science lectures, hands-on experience (research and lab-oriented), field trips, and ample discussion with science experts.

Costs are approximately \$1,000 for the one-month residential institute.

Contact: S. Minocha, Plant Biology Department, University of New Hampshire, Durham, NH 03824 USA

Space Science Student Involvement Program (SSIP)

<http://www.nsta.org/programs/ssip.htm>

Since 1980, NASA and the National Science Teachers Association (NSTA) have been conducting an annual SSIP student competition. The five competitions that comprise SSIP are designed to foster greater scientific literacy among elementary, middle, and high school students, especially in the areas of aerospace science, mathematics, engineering, and technology. Thousands of teachers throughout the United States successfully use SSIP to support curricular goals, spark student interest, encourage creative thinking across disciplines, and involve students in science process skills. The competition includes the following categories: Mission to Planet Earth (MTPE); Intergalactic Art; Future Aircraft/Spacecraft Design; Mars Scientific Experiment Proposal; and Aerospace Internships.

Student teams competing in the MTPE category investigate the effect of human activity on the Earth's ecosystem, then develop a Mission Plan that addresses one of the planet's environmental dilemmas. The MTPE competition is open to teams of students in grades 6-8. Each student design team must consist of three or four students. All entries must be accompanied by a completed entry form. Winning student teams and their teachers are recognized at the SSIP National Symposium, in Washington, DC, where students present their projects.



In addition, winning students in the MTPE category receive a Space Camp scholarship. Entries are due annually by January 10; the SSIP National Symposium is held each May in Washington, DC.

Contact: Ms. Kathlyn Berry, National Science Teachers Association, Attention: SSIP Competition, 1840 Wilson Boulevard, Arlington, VA 22201-3000 USA

Students' Cloud Observations On-Line (S'COOL) Project

<http://asd-www.larc.nasa.gov/SCOOL/>

S'COOL is a component of the Clouds and the Earth's Radiant Energy System (CERES) project of Mission to Planet Earth. The first CERES instrument will be launched in late 1997 to provide global data on clouds. S'COOL Project participants will make ground truth measurements for the CERES experiment. Ground truth measurements are land-based observations to compare with satellite data for the purpose of improving the satellite results.

A series of trial periods for the experiment were conducted during calendar year 1997, using instruments on National Oceanic and Atmospheric Administration (NOAA) weather satellites as a stand-in for CERES. By early 1998, when CERES begins returning observations, the goal is to have the S'COOL project in operation around the world.

Participating classes will be asked to make some basic weather observations and to record the type and features of clouds in the sky at the time that the NOAA satellite passes over their location. Observations will then be either

entered in an on-line form, e-mailed, faxed or mailed to NASA for entry into an on-line database. Students will have access to their results as well as those from other participating schools. Some satellite observations for matching times will also be captured so that CERES scientists can evaluate the results.

Selected participants will receive some instructional materials, satellite overpass times, and information necessary for reporting results. There is no cost to participate.

Contact: Those interested in participating should send electronic mail to scool@larc.nasa.gov or write to: Attn: S'COOL, Langley DAAC User and Data Services, Mail Stop 157D, NASA Langley Research Center, Hampton, Virginia 23681-0001 USA. The following information is requested: name of teacher; name of school and grade/age level (minimum of 3rd grade is suggested); postal and e-mail (if available) address; whether or not the class has Internet access; location (city, state and country, as well as latitude and longitude, if known)

Project SUN (Students Understanding Nature)

<http://sunshine.jpl.nasa.gov/>

Project Sun is based on the development of low-cost, scientifically-accurate instrumentation and computer interfacing, coupled with older computers such as the Apple II, Macintosh or, IBMs as dedicated data loggers. Included in a SUN kit are: instruments and interfacing, software and curriculum, a detailed operating manual, and a system of in-service training at the school sites.

Secondary students all over the world are contributing to the long-term, time-resolved monitoring of both visible and UV solar surface radiation.

Participating schools supply two Apple IIe or IIc computers or one older Macintosh or older IBM PC that are converted to dedicated data loggers for the project. In addition, participating schools must commit to supply NASA/JPL with at least two days per week of data for an entire school year to obtain the SUN kit and JPL support. This support not only includes hardware, software, and documentation, but also in-service training for teachers, student mentoring, station inspection and certification, and recognition of the school as part of the NASA/JPL Student Solar Radiation Monitoring Global Network (SSRN). JPL conditions the data from all participating data sites and presents it in a graphical form on the SUN internet site.

Project SUN is also now a partnership with the California State University, Northridge (CSUN). In January 1998 CSUN will offer Physics 595, via internet, the training course for Project SUN instructors. Project SUN will also be part of the International Science Network being developed at CSUN. Currently, Project SUN has operating stations in the USA and Australia. Stations in Indonesia, Japan, Singapore and Korea have the equipment and are gaining operational experience.

Contact: Gilbert Yanow, NASA Jet Propulsion Laboratory, Mail Stop CS/530, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; Phone: (818) 354-8060 or 354-6916; Fax: (818) 354-8080; E-mail: Gilbert.Yanow@jpl.nasa.gov



Visiting Student Enrichment Program (VSEP)

<http://sdcd.gsfc.nasa.gov/VSEP/>

VSEP offers students summer employment positions with the Universities Space Research Association (USRA), working with NASA/Goddard Space Flight Center's (GSFC) Earth & Space Data Computing Division and numerous Center organizations that may include the Laboratory for Atmospheres, Laboratory for Hydrospheric Processes, and the Global Change Data Center.

There are two project experiences available: 1) individual research experience matches the participating student with a designated staff member as mentor for about 10 weeks (June 8 - August 14, 1998 - high school students may start and stop 1-2 weeks later) at GSFC in Greenbelt, Maryland; and 2) group research experience places the student in a group of up to six students that will work together on a project also under the supervision of a designated staff member. The program also offers all participants field trips and lectures to provide broader appreciation for the mission and activities at GSFC.

The Program is open to full-time students in computer science, as well as the physical sciences and mathematics. All students will be evaluated relative to their school-level peers. College undergraduate and graduate students must have taken courses in physical and computer sciences directly related to their areas of study. High school students (limited number of

positions) will be evaluated with emphasis on their potential and extracurricular experiences, as well as on course work. Selection criteria, in the order of importance, will be academic record, letters of reference, experience, and career goals/interest in VSEP. Funding is available for approximately 20 positions. Deadline to apply to the 1998 program is January 28, 1998; selection announcements will be made by April 23, 1998.

Participating students will be made full-time temporary employees of USRA, a nonprofit academic research consortium. The compensation rate was \$5.00 per hour for high school students and \$8.00 per hour for college undergraduate/graduate students, but these amounts may be increased for 1998. For those students not within normal commuting distance to GSFC, the program will provide limited round-trip travel expenses and local housing at the University of Maryland.

Contact: Visiting Student Enrichment Program, USRA, Mail Code 610.3 NASA/Goddard Space Flight Center, Greenbelt, MD 20771 USA; Phone: (301) 805-8396; E-mail: VSEP@gvsp.usra.edu.

Undergraduate Advanced Undergraduate Research Using Optical Radiation in the Atmosphere (AURORA)

The Department of Physics at Hampton University and NASA Langley Research Center (LaRC) will sponsor AURORA, an intensive six-week undergraduate summer program, which will be held June 15-July 24, 1998. The goals of the program are to provide exceptional undergraduates with quality research experiences in atmospheric sciences and to encourage them to pursue graduate studies and careers in science. The participants will conduct cutting edge research in atmospheric science under the guidance of world-class research scientists at Hampton University and NASA LaRC. Participants will be awarded room and board on the campus of Hampton University, a \$2,000 stipend and a travel allowance.

In order to apply, students must have a minimum 3.0 grade point average, and submit an application, three letters of recommendation from professors or scientists and an official university transcript. The applications will be available and distributed to universities by the middle of December 1997. The deadline for receipt of application packages is March 15, 1998. Awards will be announced at the beginning of April 1998.



Contact: Carlane J. Pittman, Director of Outreach, Phone: (800) 254-2223; E-mail: pittman@jlab.org

Columbia University Biosphere 2 Center Intern Program

<http://www.bio2.edu>

Biosphere 2 is a unique facility — a three-acre, enclosed, ecological laboratory for studying the future of planet Earth. It has a rain forest, a million gallon ocean and marine research program; trace gas studies and a focus on agricultural challenges of the future in a high CO₂ environment. The Center is located on a beautiful 250-acre ecological site (4,000 foot elevation) and will provide students the opportunity to work a broad spectrum of research problems in and outside of the Biosphere 2 facility. It is adjacent to Tucson, Arizona and near Mt. Lemmon, the nation's southernmost ski resort. It is also two hours from Mexico and four hours from the Sea of Cortez, which complements the Center's educational programs. The program is open to students who have completed their sophomore year in college or who are near completion of a two-year community college degree. Applicants should have an interest in conducting research in the Earth sciences. Areas of study include: terrestrial ecology, agricultural research, greenhouse gases, marine ecosystems, Earth systems education and biodiversity studies. Minorities and women are especially encouraged to apply.

Participants will receive a stipend and free housing at Biosphere 2 Center in

Oracle, Arizona. Students who are traveling to Biosphere 2 from further than 200 miles away will be reimbursed for travel costs up to \$400. Air travel will be reimbursed based on 21-day advance purchase coach fare up to \$400.

Contact: Nancy Mager, Summer Internship Program, Biosphere 2 Center, Inc., PO Box 689, Oracle, AZ 85623 USA; Phone: (520) 896-6412; Fax: (520) 896-6214; E-mail: nmager@bio2.edu

Earth Systems Field Research Experience for Undergraduates

The Earth Systems Science Field Research Experience for Undergraduates is held on the Juneau Icefield, Alaska from July 1 to August 24. This field program is for undergraduate geoscience students and emphasizes a combination of interdisciplinary field studies and student-involved research in Earth systems science. A key focus is the issue of global warming and the Juneau Icefield and its 39 main outflowing glaciers in the Alaskan Panhandle. This icefield is the fifth largest in the Western Hemisphere and accessible by foot and helicopter from Juneau, Alaska's capital city. The program is expeditionary in character and involves intense seven-day a week field work for the entire period. Some experience in living under adverse wilderness conditions and cross country skiing are recommended. Twelve NASA-support scholarships, both full and partial, are available annually in 1997, 1998, and 1999, including three

academic credits through the University of Idaho, and both full and partial travel grants.

Contact: Maynard M. Miller, Glaciological and Arctic Sciences Institute, College of Mines and Earth Resources, University of Idaho, Moscow, ID 83844 USA; Phone: (208) 882-1237; Fax: (208) 882-6207; E-mail: jirp@uidaho.edu

Goddard Institute for Space Studies — Institute on Climate and Planets

<http://icp.giss.nasa.gov/>

The Institute on Climate and Planets (ICP) is a collaboration between NASA Goddard Institute for Space Studies (GISS), the City University of New York Alliance for Minority Participation, and the New York City Public Schools, which allows educators and science practitioners to form an ICP Lead and Partner School Research Network. The key goal of the ICP is to create a productive and stimulating year-round learning environment which extends NASA's climate research program from GISS to high school and college classrooms. Participating schools are dedicated to addressing New York State Learning Standards for Mathematics, Science, and Technology (based on the AAAS Project 2061), creating an advanced science learning environment for minority students, and providing them with access to professional and academic networks



through which to pursue their interests in scientific discovery.

The intensive summer ICP program held at NASA GISS, and the academic year workshops conducted by faculty at ICP Lead Schools increase the capability of students and teaching faculty to establish satellite research programs on their campuses. The result is varied education-level science teams that engage scientists, educators and students in a sustained, research-driven dialogue. This dialogue can make a significant contribution toward addressing recent calls for national and state science standards. With the support of the NASA Minority University-Space Interdisciplinary Network (MU-SPIN), the school research network is gaining the technical competence and resources needed to contribute to on-going climate research projects. One of the newest venues for this contribution is via the newly-created ICP Web site's Virtual Research Institute. Currently, this network is comprised of six junior and senior colleges and six secondary schools in the New York City area. It is expected that two colleges and three secondary schools will join the network this year.

Communication and public education about the research and education outcomes of the ICP are the collective responsibility of students, faculty, and scientists. Presentations are made annually at professional meetings, academic competitions, local conferences, and in a small number of publications. Students also organize a Saturday Space Quest program for elementary school students, as well as a Paths to Discovery Seminar Series

to engage their peers in a dialogue with science leaders about global climate change. The faculty's main contribution to ICP public education is by developing curriculum motivated by their research and field-testing in core science courses and research classes. Faculty are also working with scientists to develop an Earth Climate curriculum based on their research experiences and projects.

Contact: Carolyn Harris, NASA
Goddard Institute for Space Studies, 2880
Broadway, New York, NY 10025 USA;
Phone: (212) 678-5653; Fax: (212)
678-5552; E-mail: charris@giss.nasa.gov

NASA Academy

<http://www.nasa-academy.nasa.gov>

NASA's Charter gives it the main role of using and exploring space for the benefit of humankind. The success of the space program results from the interaction of government, academia, and the private sector, each playing a critical and different role. Responsibilities overlap, leaders migrate from one sector to another, and interdependence changes with each new administration. The NASA Academy is a unique institute of higher learning whose goal is to help guide future leaders of our space program by giving them a glimpse of how this system works.

The intent of this program is to give the selected students a working knowledge of NASA and its programs. The Academy accomplishes this through interactive sessions with leaders within government,

industry, and academia and research in NASA's laboratories. The students will discover how NASA and its Field Centers operate, understand the NASA link to the private sector, gain experience in world-class laboratories, participate in a team environment where people work together to accomplish common goals, and build professional bonds among our future leaders.

The NASA Academy was initially started in 1993 at Goddard Space Flight Center (GSFC); In 1997 Academies were started at both the Dryden Flight Research Center and the Ames Research Center and an Academy is expected to begin at the Kennedy Space Center.

Student eligibility requirements include:

- a demonstrated interest in the space program;
- enrollment (as of June 1 of the program year) as a junior, senior, or early graduate student;
- a minimum B average;
- a major in science (physics, chemistry, biology, etc.), mathematics, engineering, computer science, or other area of interest to the space program; and
- citizenship or permanent residence (as of June 1 of the program year).

The NASA Academy Program is co-sponsored by the National Space Grant College and Fellowship Program, which provides students with stipends between \$2,000 and \$4,000 for the summer.



Housing, meals and local transportation are paid for by the participating NASA Center.

Contact: For application materials, please check with your local Space Grant College Consortia Office (<http://calspace.ucsd.edu/spacegrant/>), the NASA Academy Home Page (<http://www.nasa-academy.nasa.gov>), or call the University Programs Office at the NASA Goddard Space Flight Center (301-286-6167).

OUR Earth: Opportunities for Undergraduate Research in Earth Systems Science

<http://weber.u.washington.edu/~nasauw/ourearth.html>

This program will provide summer research experiences to 17 talented undergraduate students each year, selected from a national pool of students from the range of disciplines involved in Earth System Science. Selected students will receive room and board on the University of Washington campus and a stipend of \$2000 for the 8-week program. Organized by the Washington Space Grant Consortium, this coordinated effort will include: direct student involvement with an ongoing Mission To Planet Earth research project; participation in a seminar series examining current issues in Earth Systems Science with an emphasis on an integrated approach to understanding global change; opportunities for students to present their work orally and in multi-media formats;

professional assistance to develop technical and presentation skills critical to a successful career in the sciences or related fields; opportunities to forge powerful connections with peers and faculty that will develop into lifelong professional and personal associations.

OUR Earth will run for three summers, beginning in 1998. All information and application materials are available at the project WWW site. Dates and deadlines for 1998 are: the summer program will be held June 22-August 14; the application deadline is March 1, 1998; and the notification date is March 30, 1998.

Eligible participants are juniors and seniors majoring in any field of Earth system science. Community college students who have completed two years of college level courses are also eligible.

Room, board and a \$2000 stipend will be provided to program participants

Contact: Janice DeCosmo, Washington Space Grant, Box 351650, University of Washington, Seattle, WA 98195-1650 USA; Phone: (206) 543-1943; Fax: (206) 685-3815; E-mail: janice@geophys.washington.edu

NSU/NASA Research Experience in Earth System Science (REESS)

<http://vigyan.nsu.edu/>

A six week program to educate Science, Mathematics, Engineering, and Technology (SMET) undergraduate students in the visualization and interpretation of satellite

data. Students will be assigned research projects relevant to NASA's Earth Science Enterprise coupled with an intense educational program.

At the end of the experience the students are expected to a) have an understanding of the Earth as a coupled system in which many interactions are critical to climate change; b) understand satellite data manipulation, image processing, and interpretations; c) be capable of accessing satellite images via Internet and making informed interpretations.

Eligible candidates must: 1) be a full time undergraduate student at a certified institution; 2) have completed a university level science and mathematics course; and 3) be a US citizen.

Applicants need to submit a completed application form; resume; list of courses completed; 300-500 word statement on the importance of studying the atmosphere; and two letters of recommendation from a professor or a work supervisor. Application forms and a complete brochure will be available beginning in November 1998.

The project will provide participants with the following support:

- stipend — amount will depend on qualifications and experience. Please see the project's Web site for details
- transportation expense from the city of residence to Norfolk, VA will be reimbursed to a maximum of \$500; and
- dormitory housing and meal plans will be available at Norfolk State University.



Contact: Waldo J. Rodriguez,
Center for Materials Research, Norfolk
State University, 2401 Corprew Avenue,
Norfolk, VA 23504 USA; Phone: (757)
683-2381; Fax: (757) 683-9054;
E-mail: waldo@vigyan.nsu.edu

Summer Fellowships in Ocean Remote Sensing

This program provides undergraduates and beginning graduate students with twelve-week summer fellowships to work with leading scientists at NASA Goddard Space Flight Center (GSFC) and the University of Maryland, College Park using remote sensing to address problems in the Earth sciences, focusing on estuarine, coastal, and oceanic processes.

Participants:

- acquire a background in the application of remote-sensing methods;
- develop an understanding of existing satellite and aircraft systems and of the data processing methods involved;
- use remote sensing to address research problems in conjunction with ongoing studies of NASA/GSFC and University of Maryland scientists;
- learn how to interpret, organize, and present the results of a scientific research project; and
- contribute to the publication of scientific data by serving as interns participating in research projects and co-authors on manuscripts.

During the summer program, students participate as members of teams, which include other students, technicians, and scientists. A brief orientation includes introductory lectures at GSFC in conjunction with other summer programs. Each student is paired with an individual scientist and pursues a study of mutual interest and agreement. The general topics that are included in each summer's program are advertised in brochures and application materials. Advanced undergraduates and beginning graduate students are eligible to participate. Students are recruited nationally and 6-9 students are selected annually. Participating students are provided a stipend, housing, and travel support.

Contact: Lawrence W. Harding, Jr.,
Maryland Sea Grant College, 0112 Skinner
Hall, University of Maryland, College Park,
MD 20742 USA; Phone: (301) 405-6372;
E-mail: larry@kestrel.umd.edu

Summer Institute on Atmospheric and Hydrospheric Sciences

[http://neptune.gsfc.nasa.gov/
sum_inst.html](http://neptune.gsfc.nasa.gov/sum_inst.html)

NASA's Goddard Space Flight Center (GSFC) convenes an annual summer institute for undergraduate students, which focuses on atmospheric and hydrospheric sciences. The first part of the program is a one-week lecture series, covering the basic areas of atmospheric and hydrospheric sciences and is given primarily by GSFC

scientists. The lecture series is followed by nine weeks of research with a GSFC scientist as a mentor. During the research period, cooperating university professors lecture on the work that is being conducted at their institutions.

The program is directed at undergraduates, majoring in one of the physical sciences, who are in their junior year at the time of application. However, all undergraduates are eligible to apply. No previous experience in atmospheric or hydrospheric sciences is needed.

There is no formal application form for this project. Applications should be submitted in the form of a letter containing the following information: (1) full name; (2) address and phone number at school; (3) permanent address and phone number at which you can always be reached; (4) current grade level; (5) current grade point average; (6) major field; (7) Social Security Number; (8) one-page typewritten statement of your professional goals and interests; (9) description of computer programming and laboratory experience, if any; (10) citizenship; (11) transcripts of any courses and grades; (12) the names of two faculty members who know your work well and have been asked to provide letter of reference. The transcripts and letters of reference should be sent directly by the university and faculty members to the address below.

The deadline for receipt of applications is in February, with awards announced in March. All applications receive consideration, without regard to race, color, age, national or ethnic origin, or sex.



Contact: Per Gloersen, NASA Goddard Space Flight Center, Code 971, Greenbelt, MD 20771 USA; Phone: (301) 286-6362; Fax: (301) 286-0240; E-mail: per.gloersen@gsfc.nasa.gov

UCSB Earth System Science Undergraduate Summer Research Program

http://www.icess.ucsb.edu/esrg/ess_sum97/ess97.html

Undergraduate students participating in this ten-week summer program receive one-on-one mentoring by research and faculty members, are actively involved in current research projects, and attend a lecture series. The last week of the series is devoted to writing a final report on the research project, which is then presented in a seminar setting and displayed in the ICES-UCSB web site (http://www.icess.ucsb.edu/esrg/ess_sum97/main.html).

Investigations in Earth System Science involve the linkages between the Earth's biosphere, oceans, lands, ice, and atmosphere. They include the use of advanced scientific computation and environmental modeling, and depend on both remote-sensing and in-situ field observation. Faculty and researchers from ICES and the School of Environmental Science and Management have designed a lecture series that includes all aspects of Earth System Science along with scientific computing and simulation, numerical methods, applied mathematics, statistics,

fluid dynamics, optics, remote sensing, and geographic information systems.

Application requirements include:

- one academic letter of recommendation;
- one page statement of interest including: 1) top three topics of interest from: physical climate systems, physical oceanography, biological oceanography, snow hydrology, geomorphology, aquatic systems, limnology, ecosystems, land remote sensing; 2) list of upper division classes completed; 3) one paragraph describing computer experience;
- one original copy of transcript, showing 3.25 GPA; and
- minimum level of computer experience.

Participants are competitively selected and receive a stipend to cover travel and living expenses. Shared lodging is provided through the University for non-Santa Barbara participants.

Contact: Charles Jones, Institute for Computational Earth System Science, 6832 Ellison Hall, University of California, Santa Barbara, CA 93106-3060 USA; Phone: (805) 893-4912; Fax: (805) 893-2578; E-Mail: cjones@icess.ucsb.edu

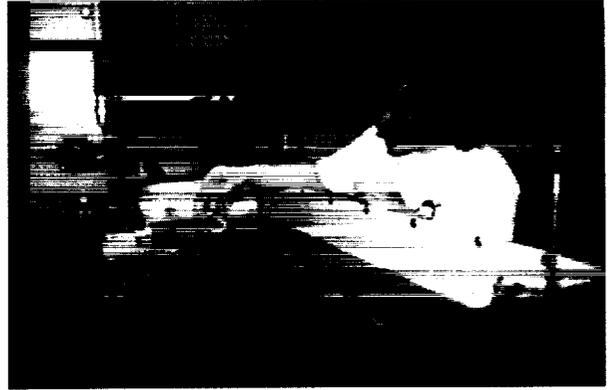
Visiting Student Enrichment Program (VSEP)

<http://sdcd.gsfc.nasa.gov/VSEP/>

VSEP offers students summer employment positions with the Universities Space Research Association (USRA), working with NASA/Goddard Space Flight Center's (GSFC) Earth & Space Data Computing Division and numerous Center organizations that may include the Laboratory for Atmospheres, Laboratory for Hydrospheric Processes, and the Global Change Data Center.

There are two project experiences available: 1) individual research experience matches the participating student with a designated staff member as mentor for about 10 weeks (June 8 - August 14, 1998 - high school students may start and stop 1-2 weeks later) at GSFC in Greenbelt, Maryland; and 2) group research experience places the student in a group of up to six students that will work together on a project also under the supervision of a designated staff member. The program also offers all participants field trips and lectures to provide broader appreciation for the mission and activities at GSFC.

The Program is open to full-time students in computer science, as well as the physical sciences and mathematics. All students will be evaluated relative to their school-level peers. College undergraduate and graduate students must have taken courses in physical and computer sciences directly related to their areas of study.



High school students (limited number of positions) will be evaluated with emphasis on their potential and extracurricular experiences, as well as on course work. Selection criteria, in the order of importance, will be academic record, letters of reference, experience, and career goals/interest in VSEP. Funding is available for approximately 20 positions. Deadline to apply to the 1998 program is January 28, 1998; selection announcements will be made by April 23, 1998.

Participating students will be made full-time temporary employees of USRA, a nonprofit academic research consortium. The compensation rate was \$5.00 per hour for high school students and \$8.00 per hour for college undergraduate/graduate students, but these amounts may be increased for 1998. For those students not within normal commuting distance to GSFC, the program will provide limited round-trip travel expenses and local housing at the University of Maryland.

Contact: Visiting Student Enrichment Program, USRA, Mail Code 610.3 NASA/Goddard Space Flight Center, Greenbelt, MD 20771 USA; Phone: (301) 805-8396; E-mail: VSEP@gvsp.usra.edu

Graduate, Postgraduate, and Postdoctorate

Earth System Science Fellowship Program

<http://www.hq.nasa.gov/office/mtpe/education>

NASA offers graduate student training fellowships for persons pursuing Master of Science (M.Sc.) or Doctoral (Ph.D.) degree in Earth System Science. The purpose of these fellowships is to ensure continued training of interdisciplinary scientists to support the study of the Earth as a system. Over 400 Ph.D. and M.Sc. fellowships have been awarded since the inception of the program in 1990.

Participating students conduct research in areas related to the near-term (1996-2000) scientific priorities of NASA's Earth Science Enterprise: seasonal-to-interannual climate prediction; long-term climate variability; land cover change and global productivity; atmospheric ozone; and natural hazards. Applications will be considered for research in atmospheric chemistry and physics, ocean biology and physics, ecosystem dynamics, hydrology, cryospheric processes, geology, and geophysics, provided that the specific research topic is relevant to NASA's Earth remote sensing science, process studies, modeling and analysis in support of the U.S. Global Change Research Program

(USGCRP). NASA discourages submission of paleo-climate related applications to this program.

Students admitted or enrolled in a full-time M.Sc. and/or Ph.D. program at accredited U.S. universities are eligible to apply. Participants are competitively selected based on their submitted research proposal and their academic credentials. Announcements are released in December for the next year's program, applications are due in March, results are announced by June 30, with anticipated start dates of awarded fellowships to be September 1 of each year.

Awards are made initially for one year and may be renewed annually, no more than two additional years for a total of three years, based on satisfactory progress as reflected in academic performance and evaluations by the faculty advisor. The amount of award for 1997/98 is \$20,000, which may be used as a stipend to defray living expenses, tuition, travel, books, supplies, and fees. An additional amount of \$2,000 is available by request for the faculty advisor's use in support of the student's research.

Contact: Additional information can be found at <http://www.hq.nasa.gov/office/mtpe/education> or by contacting: Earth System Science Fellowship Program, Code YSP-44, NASA Headquarters, Washington, DC 20546 USA; Phone: (202) 358-3552



Graduate Student Summer Program (GSSP) in the Earth System Sciences

<http://www.usra.edu>

GSFC's Earth Sciences Directorate, in conjunction with the Universities Space Research Association (USRA), sponsors a ten-week Graduate Student Summer Program in the Earth System Sciences. Participating students work on an intensive research project at GSFC for the majority of the program period. Each student is given significant latitude to choose from a pool of research projects and mentors. Project topics are developed and implemented in conjunction with scientists from the three Earth science laboratories at GSFC: The Laboratory for Atmospheres, the Laboratory for Terrestrial Physics, and the Laboratory for Hydrospheric Processes. During the project period, all participating students are invited to lunch-time sessions with a variety of GSFC researchers. Students are expected to produce oral and written reports on their summer research activities. The written reports are intended to be shared with members of the global change research community and subsequent program participants.

The program is open to all students enrolled in, or accepted to, an accredited graduate program in the physical or biological processes, mathematics, computer science, or engineering. In addition, the first five days of the summer program are dedicated to an intensive

public lecture series, which is designed to provide a comprehensive introduction to the science and techniques of remote-sensing and satellite observations.

Students are selected on the basis of academic record; proven motivation and qualification to pursue interdisciplinary or multidisciplinary research related to Earth sciences; clarity and relevance of research interests to NASA programs; and letters of recommendation.

Contact: Roberta Harvey, USRA/GSSP, 7501 Forbes Boulevard, Suite 206, Seabrook, Maryland 20706 USA; Phone: (301) 805-8396; Fax: (301) 805-8466; E-mail: robbi@gvsp.usra.edu

NASA Academy

<http://www.nasa-academy.nasa.gov>

NASA's Charter gives it the main role of using and exploring space for the benefit of humankind. The success of the space program results from the interaction of government, academia, and the private sector, each playing a critical and different role. Responsibilities overlap, leaders migrate from one sector to another, and interdependence changes with each new administration. The NASA Academy is a unique institute of higher learning whose goal is to help guide future leaders of our space program by giving them a glimpse of how this system works.

The intent of this program is to give the selected students a working knowledge of NASA and its programs. The Academy accomplishes this through interactive sessions with leaders within government,

industry, and academia and research in NASA's laboratories. The students will discover how NASA and its Field Centers operate, understand the NASA link to the private sector, gain experience in world-class laboratories, participate in a team environment where people work together to accomplish common goals, and build professional bonds among our future leaders.

The NASA Academy was initially started in 1993 at Goddard Space Flight Center (GSFC); In 1997 Academies were started at both the Dryden Flight Research Center and the Ames Research Center and an Academy is expected to begin at the Kennedy Space Center.

Student eligibility requirements include:

- a demonstrated interest in the space program;
- enrollment (as of June 1 of the program year) as a junior, senior, or early graduate student;
- a minimum B average;
- a major in science (physics, chemistry, biology, etc.), mathematics, engineering, computer science, or other area of interest to the space program; and
- citizenship or permanent residence (as of June 1 of the program year).

The NASA Academy Program is co-sponsored by the National Space Grant College and Fellowship Program, which provides students with stipends between \$2,000 and \$4,000 for the summer. Housing, meals and local transportation is paid for by the participating NASA Center.



Contact: For application materials, please check with your local Space Grant College Consortia Office (<http://calspace.ucsd.edu/spacegrant/>), the NASA Academy Home Page (<http://www.nasa-academy.nasa.gov>), or call the University Programs Office at the NASA Goddard Space Flight Center: (301) 286-6167.

NASA Summer School for High Performance Computational Physics (HPCP)

http://esdcd.gsfc.nasa.gov/ESS/basic_research.html

This three-week program is designed for graduate students pursuing doctoral degrees in the physical sciences with an interest in massively-parallel computing and is conducted through the NASA Center for Computational Sciences (NCCS), which generally provides comprehensive research in GSFC's space and Earth science programs. On the basis of application, approximately fifteen graduate students are selected each summer to participate in an intensive computational physics lecture series. During the program, the students are divided into four teams to facilitate hands-on computer training and small group interaction.

This program is open to U.S. university graduate students involved in disciplines related to the space and Earth sciences. Students should have passed their Ph.D. qualifying exams.

Participant selection is performed by a committee that evaluates candidates on the basis of demonstrated scholastic excellence, qualifications, and interests relative to space and Earth science, plus experience and/or interest in computational physics. Applications should include a curriculum vitae (or resume) with a publication list, a description of relevant experience, an academic transcript showing two full years of work, and two letters of reference. Applications for the 1998 summer program should be submitted prior to February 13, 1998.

Contact: Georgia Flanagan, USRA, Code 930.5, NASA Goddard Space Flight Center, Greenbelt, MD 20771 USA; Phone: (301) 286-4403; Fax: (301) 286-1777; E-mail: georgia@cesdis.usra.edu

Jet Propulsion Laboratory Postdoctoral/Postgraduate Associate Program

The program is under the cognizance of NASA Jet Propulsion Laboratory's (JPL) Chief Scientist, and is administered by the JPL Educational Affairs Office. Participants are engaged in research, in residence at JPL, under the guidance of research advisors who are senior, full-time staff members. All areas of research at the Laboratory are included; fields relevant to NASA's Earth Science Enterprise are heavily represented. Appointments are for one year, but may be extended for one or two additional years upon mutual

agreement. Appointees receive an annual stipend and participate in all employee benefit plans. Between thirty and forty individuals are involved in the program at any given time.

Postdoctoral Associates are recent Ph.D. recipients from universities in the United States or abroad. Postgraduate Associates are graduate students currently enrolled in an accredited university; they may be either Master's or Ph.D. candidates, but must have completed all course work required for their degrees. Appointees are normally U.S. citizens or permanent resident aliens; appointments of others must conform to NASA/JPL foreign national employment practices. Applications are accepted year-round.

Contact: University Affairs Office, Jet Propulsion Laboratory, MS 72-109, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; Phone: (818) 354-8252

National Research Council (NRC) Resident Research Associateships (RRA) Program

The NRC conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral and experienced senior levels for tenure as guest researchers at participating NASA laboratories. Recent postdoctoral graduates are provided with an opportunity for concentrated research in association with selected



members of the permanent professional laboratory staff, often as a climax to formal career preparation. Recently-established scientists and engineers are afforded an opportunity for research without the interruptions and distractions of permanent career positions. The RRA program is administered by the National Research Council under a contract monitored by NASA's Education Division.

This program is open to all Ph.D.s, or equivalent, in science and engineering disciplines relevant to NASA research programs, including NASA's Earth Science Enterprise. As many as 250 associateships are on tenure annually. Foreign nationals are eligible for this program.

Applicants must submit a research proposal that responds to a specific research opportunity at the desired NASA Field Center. These research opportunities are published annually in brochures for each Center. Awardees must hold a Ph.D., Sc.D., or other earned research doctoral degree recognized in U.S. academic circles as equivalent to the Ph.D., or must submit acceptable evidence of completion of all formal academic requirements for one of these degrees before tenure may begin. Applications, submitted directly to the NRC, are accepted on a continuous basis. The following is the general schedule for this program:

Applications postmarked by:	Will be reviewed in:
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April 15	June
August 15	October
January 15	February

Contact: National Research Council, Associateship Program - TJ 2094, 2101 Constitution Avenue, NW, Washington, DC 20418 USA; Fax: (202) 334-2759

Visiting Student Enrichment Program (VSEP)

<http://sdcd.gsfc.nasa.gov/VSEP/>

VSEP offers students summer employment positions with the Universities Space Research Association (USRA), working with NASA/Goddard Space Flight Center's (GSFC) Earth & Space Data Computing Division and numerous Center organizations that may include the Laboratory for Atmospheres, Laboratory for Hydrospheric Processes, and the Global Change Data Center.

There are two project experiences available: 1) individual research experience matches the participating student with a designated staff member as mentor for about 10 weeks (June 8 - August 14, 1998 - high school students may start and stop 1-2 weeks later) at GSFC in Greenbelt, Maryland; and 2) group research experience places the student in a group of up to six students that will work together on a project also under the supervision of a designated staff member. The program

also offers all participants field trips and lectures to provide broader appreciation for the mission and activities at GSFC.

The Program is open to full-time students in computer science, as well as the physical sciences and mathematics. All students will be evaluated relative to their school-level peers. College undergraduate and graduate students must have taken courses in physical and computer sciences directly related to their areas of study.

High school students (limited number of positions) will be evaluated with emphasis on their potential and extracurricular experiences, as well as on course work. Selection criteria, in the order of importance, will be academic record, letters of reference, experience, and career goals/interest in VSEP. Funding is available for approximately 20 positions. Deadline to apply to the 1998 program is January 28, 1998; selection announcements will be made by April 23, 1998.

Participating students will be made full-time temporary employees of USRA, a nonprofit academic research consortium. The compensation rate was \$5.00 per hour for high school students and \$8.00 per hour for college undergraduate/graduate students, but these amounts may be increased for 1998. For those students not within normal commuting distance to GSFC, the program will provide limited round-trip travel expenses and local housing at the University of Maryland.

Contact: Visiting Student Enrichment Program, USRA, Mail Code 610.3 NASA/Goddard Space Flight Center, Greenbelt, MD 20771 USA; Phone: (301) 805-8396; E-mail: VSEP@gvsp.usra.edu

Teacher/Faculty Preparation and Enhancement

Teacher preparation and enhancement activities are a key part of NASA's Earth Science Enterprise Education Program. Pre-service programs provide an opportunity for Earth system science to be included as part of a teacher's degree program or certification, as well as in-service, continuing education activities and programs that update skills, as well as enrich and strengthen the theoretical and practical basis for classroom and laboratory instruction. Programs include workshops, courses, internships, and other activities that encourage incorporating Earth system science content into existing courses and curriculum related to science, mathematics, engineering, and technology.

NASA also sponsors programs designed for college and university faculty, to enrich their scientific and technical expertise and help them to establish NASA research contacts. These programs include workshops and working experiences at NASA Centers.

Pre-Service

CISAT Pre-Service/ Teacher Enhancement Workshop

<http://www.cisat.jmu.edu/projects/nasa>

The Center for Applying Science and Technology (CAST) and NASA RISE of the College of Integrated Science and Technology at James Madison University will conduct a one-week pre-service teacher enhancement workshop the third week of June 1998 and 1999. The minds-on, hands-on workshop will use the NASA MINDS 2000+ and NASA Project NOVA pre-service models to help pre-service students and in-service teachers learn how to teach an interdisciplinary Earth system science approach using NASA Earth Science Enterprise curriculum materials, data and information. The workshop is limited to 22 pre-service students and 8 teachers. Each pre-service student will receive one (1) university credit and each in-service teacher will receive one (1) CEU approved by the Commonwealth of Virginia's Department of Education.

This one-week workshop will help future teachers to:

- learn through minds-on, hands-on modeling and demonstrating experiences, innovative instruction, content, technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information.

- practice and replicate innovative instruction, content, educational technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information.

- learn how to develop innovative instruction that is based on the national standards and benchmarks for mathematics, science, and technology and involves the research and development areas of NASA's Earth Science Enterprise and other NASA resources.

Contact: James L. Barnes, College of Integrated Science and Technology, James Madison University, Harrisonburg, VA 22807 USA; Phone: (540) 568-3154; Fax: (540) 568-2761; E-mail: barnesjl@jmu.edu

Concepts and Pedagogical Strategies in Earth System Science Education for K-12 Teachers of Science and Environmental Education

Richard Busch, West Chester University, West Chester, PA 19383 USA; Phone: (610) 436-2716; Fax: (610) 436-3036; E-mail: rbusch@wcupa.edu



A Cross-Disciplinary Literacy Course on Earth System Science for Teachers in the 21st Century

<http://www.pitt.edu/~aap/>

The University of Pittsburgh at Bradford is offering a one-week interdisciplinary workshop on Earth system science aimed at preparing pre-service education students and in-service teachers for the 21st Century. The objective of this cross-disciplinary teacher training course is to develop in students an understanding of the Earth and life processes shaping the past, present, and future. The course provides hands-on training and experience in applied environmental problem-solving through field work, lab practicals, and space-based image technology.

The project will recruit a group of 16 energetic students of education and in-service teachers to participate in the week-long course: "Teacher Training on Applied Earth System Science," July 12-17, 1998. Applicants must be either undergraduate students of at least junior standing in an accredited teacher training program, or participating in a certification program. Applications will be evaluated and 25 percent of the chosen participants will be selected from in-service educators.

The workshop is free of charge. Participants will be provided with room and board, tuition, and supplies. Successful participants will be awarded one college credit for pre-service or one continuing education credit for in-service participants.

Contact: To apply use the electronic application form at <http://www.pitt.edu/~aap/> or contact: Assad A. Panah, Professor, Geology and Environmental Science, Teacher Enhancement Workshop, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701-2898 USA; Phone: (814) 362-7569; Fax: (814) 362-5088; E-mail: aap+@pitt.edu

Earthworks: Educating Teachers in Earth System Science

This one-week workshop provides an opportunity for teachers to investigate Earth system science — the study of how land, air, water, biota, and space interact to form a dynamic whole. Participants will work with scientists and each other to develop their understanding and appreciation of the Earth. This workshop is designed for pre-service and new in-service teachers, who are interested or involved in teaching secondary science. It will be held August 2-7, 1998 at the University of Colorado, Boulder, Colorado.

The goals of the workshop are to provide teachers with a self-directed learning experience in which they can develop an understanding of Earth systems and share that understanding with others; and to foster an ongoing community, including teachers and scientists, that will be maintained throughout the school year.

Cost to participants will be minimal (most expenses will be covered, including child care), however, those with high

transportation expenses may need to find additional sources of funding.

Contact: Ken Emo, CIRES, Campus Box 216, University of Colorado, Boulder, CO 80309 USA; Phone: (303) 492-5657; Fax: (303) 492-1149; E-mail: Kenneth.Emo@colorado.edu

Introductory Training for Pre-Service Teachers In Earth System Science

www.geo.utep.edu

The University of Texas at El Paso (UTEP) is involved in several initiatives to improve science education within the El Paso area public schools. These include outreach efforts into the classrooms; training programs for in-service teachers; and the introduction of a strong pre-service Science Core Curriculum. This project combines the goals of these initiatives into a multi-year series of Earth system science workshops for pre-service and in-service teachers using NASA Earth Science Enterprise materials and materials developed specifically for this region through the Pan American Center for Earth and Environmental Sciences (PACES), a NASA-funded University Research Center. Five workshops will present an Earth system science perspective using NASA and UTEP materials. Each workshop will focus on one aspect of Earth system science: an introductory workshop; the lithosphere; the biosphere; the atmosphere and hydrosphere; and astronomy. A sixth, and



final, workshop will consist of a field trip to the NASA Regional Educator Resource Center maintained by the New Mexico Space Grant Consortium located at New Mexico State University in Las Cruces, New Mexico. The El Paso area satellite images processed by PACES and the lesson plans developed by the workshop participants will be available via the PACES web site at UTEP.

The goals of the workshops are to:

- Integrate an Earth system science perspective and the use of technology into current Science Core Curriculum subjects through the use of NASA materials.
- Make the concept of Earth system science relevant by incorporating regional images, both ground and satellite, into the workshops, cooperating with local NASA University Research Center (PACES) to select and process the satellite images.
- Familiarize workshop participants with available NASA materials in a hands-on environment, emphasizing constructivist activities.
- Work in cooperative learning groups to develop lesson plans to accompany NASA satellite images and regionally-relevant images.
- Put pre-service teachers in contact with in-service teachers for future referral.

The workshop is free, participants are selected competitively.

Contact: Vicki Harder, Principal Investigator, University of Texas at El Paso, El Paso, Texas 79968 USA; Phone: (505) 589-9447; Fax: (505) 589-9448; E-mail: vharder@aol.com or Rebecca L. Dodge, Co-Investigator, University of Texas at El Paso, El Paso, Texas 79968 USA; Phone: (915) 747-5305; Fax: (915) 747-7876; E-mail: dodge@geo.utep.edu

Mission Possible: Earth System Science, the Curriculum, and You

This three-week interim course is intended to provide pre-service elementary and middle-school teachers with the opportunity to become familiar with the interdisciplinary field of Earth system science. The course will provide participants with hands-on training with NASA curriculum support materials and introduce them to national and local resources, with help from education specialists from the South Dakota Space Grant Consortium and NASA Johnson Space Center. Representatives from EROS Data Center (EDC) will provide educational materials and training on EDC resources. Participants will learn how to use the interactive multimedia technology resource - "The Voyage of the Mimi" - an integrated set of concepts that involve students in math, science, social studies, and language arts related to Earth system science. The opportunity to become proficient in the use of image processing in the classroom will also be provided.

Eligible participants are pre-service elementary and middle-school students at Augustana College and other colleges in the South Dakota Space Grant Consortium participating in the interim course concept.

The cost of tuition is included in the annual tuition costs for each student - no extra costs are anticipated. Students from other colleges will pay room and board, however room and board is available for up to three visiting students.

Contact: Valerie Keeling Olness, Department of Biology, Augustana College, 2001 Summit Avenue, Sioux Falls, South Dakota 57197 USA; Phone: (605) 336 4720; Fax: (605) 336 4492; E-mail: olness@inst.Augie.edu

Planet Earth Workshop for Teachers of Physical Science

A one-week (five full days) workshop for pre-service education students will be conducted in early June of 1998, which extends group activity-centered instruction being introduced at the University of New Orleans. That instruction includes modules on light and naked eye astronomy. The workshop will extend the modules on light by considering the interactions of light with Earth's atmosphere from the perspectives of an Earth bound (student) observer and an observer (NASA images) in orbit around the Earth. The interactions of light with Earth's atmosphere will be contrasted with light phenomena in the absence of an atmosphere, as on the moon.



The workshop will include one day working in a computer laboratory with direct access to the WWW. Participants will access and download teacher resource material available through NASA and other URLs. The workshop will also include a one-day visit to the NASA Stennis Space Center's Educator Resource Center.

Contact: J. Sullivan, Professor of Physics, University of New Orleans, New Orleans, LA 70148-2840 USA; Phone: (504) 280-6341; Fax: (504) 280-6048; E-mail: jjsph@uno.edu

Pre- and in-service Earth Science Training Opportunity (PESTO)

<http://www.gcric.org/agci-home.html>

PESTO is an Earth system science teacher enhancement summer workshop offered by the Aspen Global Change Institute (AGCI) for K-12 teachers and undergraduate students pursuing a career in education. During the week-long workshop, participants explore current understanding in the interaction of land, air, water, biota and human activities as they relate to global environmental change. Participants produce a portfolio of their work including the development of student activities. A variety of methods are employed including peer instruction, hands-on activities, presentation, discussion and an introduction to existing NASA and related educational materials and websites. A unique feature of the course is

the interaction with visiting scientists from the Aspen Global Change Institute's summer interdisciplinary program for research scientists. Faculty include Richard Somerville, Professor, Scripps Institution of Oceanography; Milton McClaren, Associate Professor and Director of In-service Education for Simon Fraser University; and John Katzenberger, Director, Aspen Global Change Institute. Course materials include NASA education products, AGCI's *Ground Truth Studies Teacher Handbook*, and *The Forgiving Air: Understanding Environmental Change*, by Richard Somerville. Partnering institutions in addition to NASA and AGCI are the University of Northern Colorado, Colorado Mountain College, Adams State College, and the Aspen Educational Research Foundation. Graduate and undergraduate credit is available (three credit hours).

AGCI is an independent non-profit organization. Its mission is to further the scientific understanding of Earth systems through interdisciplinary science seminars, publications, and educational programs about global environmental change science.

Tuition, course materials, lodging, and meals are provided for workshop participants.

Contact: Course applications for the 1998 and 1999 summer programs are available from Jenifer Blomquist, Aspen Global Change Institute, 100 East Francis, Aspen CO 81611 USA; Phone: (970) 925 7376; Fax: (970) 925 7097; E-mail: jenifer@agci.org.

Pre-Service and In-Service Teacher Enhancement Using a Space Camera

Contact: Wallace Fowler, University of Texas Austin, Austin, TX 78759-5321 USA; Phone: (512) 471-3583; Fax: (512) 471-3585; E-mail: fowler@csr.utexas.edu

Pre-Service K-12 Teacher Workshops for Earth Systems Science & Policy

Contact: Jack F. Paris, California State University Monterey Bay, Seaside, CA 93955-8001 USA; Phone: (408) 582-4221; Fax: (408) 582-4122; E-mail: jack_paris@montrey.edu

Summer of Seasons

<http://vigyan.nsu.edu/>

A one-week workshop to provide emerging educators with the familiarity and knowledge to utilize in the classroom curriculum materials that have been developed for topics in Earth System Science. Summer of Seasons will be held at Norfolk State University, B.E.S.T. Lab, June 21-27 1998 (tentative). The following fundamental skills will be introduced and reinforced as necessary:

- use of Internet to access data from NASA's Distributed Access Archive Centers (DAAC);
- use of digital sensors connected to computer or graphing calculators for laboratory data acquisition (for use in classroom activities);



- use of image processing and scientific visualization software (e.g. NIH Image, ClimateWatcher); and
- application of scientific method of inquiry in teaching Earth System Science.

Upon completion of the workshop all participants will receive free copies of NASA educator materials including a test version of the DAAC's CD-ROM being jointly developed by NSU and NASA Langley Research Center. Also included is a B.E.S.T. Lab publication *Science Writing Tips* to help students write better scientific reports.

There is no cost to participate; if credits are desired, graduate course credit is available through NSU Physics department at a reduced rate.

Contact: S. Raj Chaudhury, E-mail: schaudhury@vger.nsu.edu or Dr. Gae Golembiewski, E-mail: ggolem@vger.nsu.edu, B.E.S.T. Lab/CMR, Norfolk State University, 2401 Corprew Avenue, Norfolk VA 23504 USA; Phone: (757) 683-2381; Fax: (757) 683-9054

Umass Planet Earth Education Program

The UMass Planet Earth Education Program will serve 21 pre-service and 7 in-service middle school (grades 4-9) teachers each year, and is built around the concept that the best way to learn science is to do science, that is, to do original research. An intensive one week workshop in August will feature content presentations and hands-on Earth systems explorations focusing on the hydrosphere, the atmo-

sphere, and their interactions; discussions of pedagogical strategies; and training in using the Internet for electronic mail, finding information on the world wide web, and accessing NASA databases and other Earth systems resources. Research teams of four participants will plan and carry out their own brief investigations in Earth systems areas which combine laboratory or field studies with NASA data. Their research will be reported in presentations at the end of the week and will model the studies that their own students will later undertake. The participants will also spend an additional week in workshops devoted to science teaching methods or in a fall semester program of classroom Earth systems research plus three Saturday workshops. These complementary programs will make it possible for the participants to receive 3 academic credits or an equivalent number of Professional Development Points.

Contact: Morton M. Sternheim, University of Massachusetts Amherst, Amherst, MA 01003 USA; Phone: (413) 545-1908; Fax: (413) 545-4884; E-mail: mms@k12.oit.umass.edu

Elementary and Secondary

Boreal Forest Watch

<http://www.bfw.sr.unh.edu/>

Boreal Forest Watch (BFW) is an educational outreach program for the Boreal Ecosystem-Atmosphere Study (BOREAS). BFW involves 9-12 graders in conducting real research as part of their

educational experience. Teachers and students practice the scientific method by participating in an on-going research project. They are able to integrate multidisciplinary skills in a problem-solving approach. All activities within the program meet or exceed provincial educational standards in science, mathematics, and other fields.

BFW takes place in the boreal ecosystem region of northern Saskatchewan and Manitoba, Canada. Students and teachers from several area schools near Prince Albert, SK and Thompson, MB conduct environmental monitoring studies in the boreal forests which are near their schools. Students set up permanent sampling plots and assess the current condition of this plot. They also collect data such as tree height, diameter, overstory and understory species composition, tree core analysis, land cover mapping and remote sensing activities, and plant anatomical characteristics among many other measurements and activities. These data are collected and archived for future use in ecological monitoring studies of the boreal region as well as in class studies.

Teachers involved with BFW are trained on how to conduct program activities, which includes introduction and training in remote-sensing principles. Intensive BFW training workshops are held periodically, tentative plans are to hold a refresher workshop for current teachers in the Prince Albert area and the Thompson area, during the fall or winter of 1997-1998.



Contact: Shannon Spencer, Complex of Earth, Oceans, and Space, Morse Hall, University of New Hampshire, Durham, NH 03824 USA; Phone: (603) 862-1792; Fax: (603) 862-0188; E-mail: shannon.spencer@unh.edu

CISAT Pre-Service/Teacher Enhancement Workshop

<http://www.cisat.jmu.edu/projects/nasa>

The Center for Applying Science and Technology (CAST) and NASA RISE of the College of Integrated Science and Technology at James Madison University will conduct a one-week pre-service teacher enhancement workshop the third week of June 1998 and 1999. The minds-on, hands-on workshop will use the NASA MINDS 2000+ and NASA Project NOVA pre-service models to help pre-service students and in-service teachers learn how to teach an interdisciplinary Earth system science approach using NASA curriculum materials, data and information. The workshop is limited to 22 pre-service students and 8 teachers. Each pre-service student will receive one (1) university credit and each in-service teacher will receive one (1) CEU approved by the Commonwealth of Virginia's Department of Education.

This one-week workshop will help future teachers to:

- learn through minds-on, hands-on modeling and demonstrating experiences, innovative instruction,

content, technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information.

- practice and replicate innovative instruction, content, educational technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information.
- learn how to develop innovative instruction that is based on the national standards and benchmarks for mathematics, science, and technology and involves the research and development areas of NASA's Earth Science Enterprise and other NASA resources.

Contact: James L. Barnes, College of Integrated Science and Technology, James Madison University, Harrisonburg, VA 22807 USA; Phone: (540) 568-3154; Fax: (540) 568-2761; E-mail: barnesjl@jmu.edu

A Cross-Disciplinary Literacy Course on Earth System Science for Teachers in the 21st Century

<http://www.pitt.edu/~aap/>

The University of Pittsburgh at Bradford is offering a one-week interdisciplinary workshop on Earth system science aimed at preparing pre-service education students and in-service teachers for the 21st Century.

The objective of this cross-disciplinary teacher training course is to develop in students an understanding of the Earth and life processes shaping the past, present, and future. The course provides hands-on training and experience in applied environmental problem-solving through field work, lab practicals, and space-based image technology.

The project will recruit a group of 16 energetic students of education and in-service teachers to participate in the week-long course: "Teacher Training on Applied Earth System Science," July 12-17, 1998. Applicants must be either undergraduate students of at least junior standing in an accredited teacher training program, or participating in a certification program. Applications will be evaluated and 25 percent of the chosen participants will be selected from in-service educators.

The workshop is free of charge. Participants will be provided with room and board, tuition, and supplies. Successful participants will be awarded one college credit for pre-service or one continuing education credit for in-service participants.

Contact: To apply use the electronic application form at <http://www.pitt.edu/~aap/> or contact: Assad A. Panah, Professor, Geology and Environmental Science, Teacher Enhancement Workshop, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701-2898 USA; Phone: (814) 362-7569; Fax: (814) 362-5088; E-mail: aap+@pitt.edu



Discover Earth

<http://www.strategies.org>

Discover Earth is a NASA-sponsored project, conducted by the Institute for Global Environmental Strategies (IGES), for exceptional teachers of grades 5-12 who want to expand their knowledge of the Earth system and prepare to become master teachers who promote Earth system science in their own schools, counties, and throughout their state. Participating teachers work with scientists and other educators during a two-week summer workshop to:

- enhance their understanding of the Earth as an integrated system;
- enhance their interdisciplinary science knowledge; and
- develop materials for their own classrooms and NASA publication.

Participants don't need to be science experts, but they do need to be willing to explore sophisticated content. Datasets and on-line resources will be used to enable an inquiry-based approach.

Discover Earth is an IGES collaboration with the Earth System Science Center of The Pennsylvania State University and the Department of Meteorology of the University of Maryland, College Park.

Teachers from the following states are invited to apply: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and Washington, DC. Each summer, Discover Earth examines different topics related to the key issues of global climate change; the 1998

workshop will be held in July, at the University of Maryland, College Park and will focus on the following topics: overview of the Earth system; oceans, circulation, productivity, air-sea exchange; ice sheets, polar and alpine glaciers, seasonal snow; sources of information; and student investigations/classroom activities.

Course and classroom materials, accommodations, travel costs, and daily expenses are provided. Participants will also receive \$500 honorarium upon successful completion of the workshop. Discover Earth applications and education materials are available at IGES' WWW site.

Contact Information: Colleen Steele, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201 USA; Phone: (703) 875-8634; Fax: (703) 875-8635; E-mail: colleen_steele@strategies.org

Earth System Science On-line Course

<http://www.cotf.edu/mtpe>

NASA's Classroom of the Future (COTF) has developed an on-line middle school teachers' Earth system science course, which was first offered to teachers in spring 1997, through the Center for Educational Technologies at Wheeling Jesuit University. This 16-week course engaged groups of teachers in on-line discussions concerning the impact of major Earth events. Each event, such as a volcanic eruption or hurricane, was explored in a system context. Teachers conducted individual research; contributed

to group discussions; and collected, posted and shared Earth system science resources. The course will be offered on-line during fall 1997 through the University of Idaho (contact: Dr. Bob Kearney, bkearney@uidaho.edu). Colleges and school districts interested in offering this course from their server are welcome to obtain the software and documentation, free of charge, by contacting Robert Myers, COTF. The current version of the course may be viewed at <http://www.cotf.edu/mtpe>.

COTF is currently designing an on-line Earth system science course for K-4 teachers. The first offering of this course will be in January 1998; teachers interested in helping to pilot the K-4 course should contact Bob Myers at COTF (see below). Tuition assistance will be provided for the three graduate credit hours.

Contact: Robert J. Myers, Senior Instructional Designer, NASA Classroom of the Future, 316 Washington Avenue, Wheeling Jesuit University, Wheeling, West Virginia 26003 USA; Phone: (304) 243-2368; Fax: (304) 243-2497; E-mail: bmyers@cotf.edu

Earthworks: Educating Teachers in Earth System Science

This one-week workshop provides an opportunity for teachers to investigate Earth system science — the study of how land, air, water, biota, and space interact to form a dynamic whole. Participants will work with scientists and each other to develop their understanding and apprecia-



tion of the Earth. This workshop is designed for pre-service and new in-service teachers, who are interested or involved in teaching secondary science. It will be held August 2-7, 1998 at the University of Colorado, Boulder, Colorado.

The goals of the workshop are to provide teachers with a self-directed learning experience in which they can develop an understanding of Earth systems and share that understanding with others; and to foster an ongoing community, including teachers and scientists, that will be maintained throughout the school year.

Cost to participants will be minimal (most expenses will be covered, including child care), however, those with high transportation expenses may need to find additional sources of funding.

Contact: Ken Emo, CIRES, Campus Box 216, University of Colorado, Boulder, CO 80309 USA; Phone: (303) 492-5657; Fax: (303) 492-1149; E-mail: Kenneth.Emo@colorado.edu

Forest Watch

<http://www.nhsgc.unh.edu/outreach.html>

The University of New Hampshire (UNH) has developed Forest Watch — a New England-wide environmental outreach activity designed to introduce both teachers and their students to field, laboratory, and satellite data analysis methods for assessing the state-of-health of local forest stands. Forest Watch workshops are designed to help K-12 teachers introduce their students to selected hands-on techniques, based on University research methods, for evaluating the health of white pine (*Pinus strobus*), a

known bio-indicator for tropospheric or low-level ozone damage. Through Forest Watch, students become actively involved in doing meaningful scientific research, and in the process, collect and compile data useful to UNH researchers conducting a regional survey of white pine health in New England. Future Forest Watch collection activities will be expanded into New York, Pennsylvania, New Jersey, and Maryland and other areas where white pine occurs.

Beginning in late April, on or around Earth Day (April 22), students participate in three types of activities in Forest Watch, each patterned after activities conducted by professional remote-sensing scientists:

- 1) forest stand assessment, including selection of local white pine trees for study,
- 2) laboratory-based assessment of foliar damage symptoms for the selected trees, and
- 3) image processing/data analysis of Landsat Thematic Mapper (TM) data for the area around their school. Their field and laboratory measurements are sent to the University of New Hampshire, where they are analyzed and integrated into an on-going regional white pine study and each year a compilation of Forest Watch results is published.

Similar environmental education programs currently under development at UNH include Boreal Forest Watch (involving high schools and middle schools in Saskatchewan and Manitoba, Canada) and Czech Forest Watch (involving K-12 schools in the Czech Republic). These programs provide participating Forest Watch students with opportunities to

communicate their studies and findings with students in other countries who are conducting similar studies.

Contacts: Dr. Barry Rock (Program Director) or Mr. Gary Lauten (Program Coordinator), Complex Systems, Research Center, Morse Hall, University of New Hampshire, Durham, NH 03824 USA; Phone: (603) 862-1792; Fax: (603) 862-0188; E-mail: barry.rock@unh.edu or gary.lauten@unh.edu

The Gaia Crossroads Project

<http://www.bigelow.org>

The Gaia Crossroads project is an innovative program using satellite remote sensing in K-12 classrooms. This progressive program captures the interest of elementary students and strives to sustain their interest through high school. Using the imagery provided, students are able to study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage—the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support

The Gaia Crossroads Project's long-range plan is to: a) Develop and publish materials for teachers and students; b) Expand the project to include public



libraries in towns where the project is conducted in schools; c) Develop new strands, for example, geographic information systems; coastal processes, estuaries, inland waterways; and conducting local research projects; d) Produce a series of CD-ROMS containing images and public domain software, documentation, and tutorials; e) Provide a full range of educational opportunities for teachers including a national training conference; f) Sustain and expand the project while providing ongoing teacher support; g) Set up an advisory council.

The Gaia Crossroads Project Teachers Guidebook for Using Satellite Imagery in the Classroom and Community will be available in 1998. It contains a remote-sensing primer, hands-on tutorials, teaching resources, and over sixty activities written by teachers participating in the Gaia Crossroads Project.

Contact: Cynthia B. Erickson, Project Co-Director, The Gaia Crossroads Project, Bigelow Laboratory for Ocean Sciences, P.O. Box 475, McKown Point, West Boothbay Harbor, ME 04575-0475 USA; Phone: (207) 633-9600; Fax: (207) 633-9641; E-mail: gaiaxroads@bigelow.org

Global Learning and Observations to Benefit the Environment (GLOBE)

<http://www.globe.gov>

GLOBE is a worldwide network of K-12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near

their schools and report their data via the Internet. GLOBE environmental measurements are in the following study areas: Atmosphere/Climate; Hydrology/Water Chemistry; and Biology/Geology. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Each day, images created from the GLOBE student data sets are posted on the World Wide Web, allowing students and visitors to the GLOBE web site to visualize the student environmental observations. Teachers and students from over 4,000 schools in over 55 countries currently participate in GLOBE.

An interagency team manages GLOBE, which includes NASA, the National Oceanic and Atmospheric Administration, the National Science Foundation, the Environmental Protection Agency, and the Departments of Education and State.

There is no cost to apply, however schools must provide travel for teachers to attend GLOBE training, equipment for making measurements, computer, and internet connection to the WWW.

Contact Information: GLOBE Program, 744 Jackson Place, Washington, DC 20503 USA; Phone: (800) 858-9947; E-mail: info@globe.gov

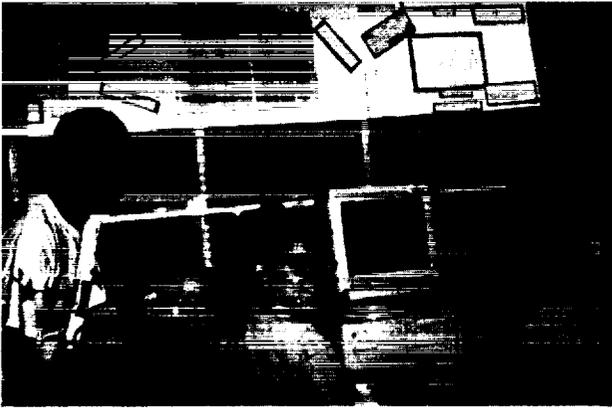
Goddard Institute for Space Studies — Institute on Climate and Planets

<http://icp.giss.nasa.gov/>

The Institute on Climate and Planets (ICP) is a collaboration between NASA

Goddard Institute for Space Studies (GISS), the City University of New York Alliance for Minority Participation, and the New York City Public Schools, which allows educators and science practitioners to form an ICP Lead and Partner School Research Network. The key goal of the ICP is to create a productive and stimulating year-round learning environment which extends NASA's climate research program from GISS to high school and college classrooms. Participating schools are dedicated to addressing New York State Learning Standards for Mathematics, Science, and Technology (based on the AAAS Project 2061), creating an advanced science learning environment for minority students, and providing them with access to professional and academic networks through which to pursue their interests in scientific discovery.

The intensive summer ICP program held at NASA GISS, and the academic year workshops conducted by faculty at ICP Lead Schools increase the capability of students and teaching faculty to establish satellite research programs on their campuses. The result is varied education-level science teams that engage scientists, educators and students in a sustained, research-driven dialogue. This dialogue can make a significant contribution toward addressing recent calls for national and state science standards. With the support of the NASA Minority University-Space Interdisciplinary Network (MU-SPIN), the school research network is gaining the technical competence and resources needed to contribute to on-going climate research projects. One of the newest



venues for this contribution is via the newly-created ICP Web site's Virtual Research Institute. Currently, this network is comprised of six junior and senior colleges and six secondary schools in the New York City area. It is expected that two colleges and three secondary schools will join the network this year.

Communication and public education about the research and education outcomes of the ICP are the collective responsibility of students, faculty, and scientists. Presentations are made annually at professional meetings, academic competitions, local conferences, and in a small number of publications. Students also organize a Saturday Space Quest program for elementary school students, as well as a Paths to Discovery Seminar Series to engage their peers in a dialogue with science leaders about global climate change. The faculty's main contribution to ICP public education is by developing curriculum motivated by their research and field-testing in core science courses and research classes. Faculty are also working with scientists to develop an Earth Climate curriculum based on their research experiences and projects.

Contact: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025 USA; Phone: (212) 678-5653; Fax: (212) 678-5552; E-mail: charris@giss.nasa.gov

Goddard Space Flight Center Earth System Science Education Project (GESSEP) — Maryland School System Grants and Regional Earth Science Activities

As an extension to the Maryland Ambassador Program, during 1997 and 1998 each Maryland Ambassador working in concert with their county science supervisor and county superintendent may propose a plan of action to be funded by the GESSEP project. These plans will address the enhancement of Earth science literacy of teachers in the local school system. Teacher enhancement will be based on the use of technology and training in Earth system science and NASA curriculum materials. The criteria for these grants will be developed consistent with the reform effort in science of the Maryland State Department of Education, the National Science Standards, and NASA GSFC enterprises and missions. Training will also be provided to participating educators in the use and implementation of the NASA Evaluation Program (EDCATS). In addition the Project will support eight Regional Earth Science Activities to be conducted during the 1997-1998 school year, which will include two activities held in each of Maryland's four geographic regions.

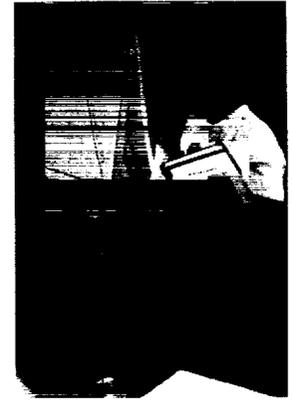
The Maryland Ambassador Program began in the summer of 1994 and

continued through the end of the 1996 school year. Teams of Maryland middle and high school science teachers participated in this program, which was designed to help the teachers enhance their teaching and to serve as ambassadors to other teachers and to their local school district. During their four-week summer session at Goddard Space Flight Center and at the University of Maryland, the Ambassadors received training in: gathering data by satellites to monitor conditions on Earth; the Maryland environment; use of the Internet; the integrated sciences of NASA's Earth Science Enterprise; and the use of computers to enhance teaching. Sixty-five teachers completed the Ambassador Program from across Maryland.

Contacts: Stephen Gilligan, Principal Investigator; Phone: (301) 283-4338; E-mail: charles1@mail.ameritel.net; or Vern Smith, Co-Investigator, Phone: (301) 286-1977; E-mail: vern@aesp.nasa.okstate.gov

Goddard Space Flight Center (GSFC) Teacher Intern Program

Local Maryland teachers are selected by application and work with scientists, mathematicians, computer technologists, and engineers for six weeks each summer. The teacher will learn about the scientist's project and will develop an educational component— past educational projects have included video animation and lab experiments. This internship is developed



as a partnership, therefore the teacher and the scientist will determine their working relationship. Final selection is determined by an interview with the scientist.

Eligible participants are local certified teachers, who have been teaching for a minimum of two years, and have competent computer skills. Applications are due in late February each year to the Prince George's County Public School Science Office, attention James Strandquist. Approximately 10 teachers are selected for the summer internship; many are placed with GSFC's Earth Science Directorate.

Contacts: Elaine Lewis, Goddard Space Flight Center, Code 130.3, Greenbelt, Maryland 20771 USA; Phone: (301) 286-7356; Fax: (301) 286-1707; E-mail: elewis@pop100.gsfc.nasa.gov or James Strandquist, Supervisor of Science, Prince George's County Public School Science Office, 9201 East Hampton Drive, Capital Heights MD 20743 USA; Phone: (301) 808-8251

Introductory Training for Pre-Service Teachers in Earth System Science

<http://www.geo.utep.edu>

The University of Texas at El Paso (UTEP) is involved in several initiatives to improve science education within the El Paso area public schools. These include outreach efforts into the classrooms; training programs for in-service teachers; and the introduction of a strong pre-service Science Core Curriculum. This project

combines the goals of these initiatives into a multi-year series of Earth System Science workshops for pre-service and in-service teachers using NASA Earth Science Enterprise materials and materials developed specifically for this region through the Pan American Center for Earth and Environmental Sciences (PACES), a NASA-funded University Research Center. Five workshops will present an Earth system science perspective using NASA and UTEP materials. Each workshop will focus on one aspect of Earth system science: an introductory workshop; the lithosphere; the biosphere; the atmosphere and hydrosphere; and astronomy. A sixth, and final, workshop will consist of a field trip to the NASA Regional Educator Resource Center maintained by the New Mexico Space Grant Consortium located at New Mexico State University in Las Cruces, New Mexico. The El Paso area satellite images processed by PACES and the lesson plans developed by the workshop participants will be available via the PACES web site at UTEP.

The goals of the workshops are to:

- Integrate an Earth system science perspective and the use of technology into current Science Core Curriculum subjects through the use of NASA materials.
- Make the concept of Earth system science relevant by incorporating regional images, both ground and satellite, into the workshops, cooperating with local NASA University Research Center (PACES) to select and process the satellite images.

- Familiarize workshop participants with available NASA materials in a hands-on environment, emphasizing constructivist activities.
- Work in cooperative learning groups to develop lesson plans to accompany NASA satellite images and regionally-relevant images.
- Put pre-service teachers in contact with in-service teachers for future referral.

The workshop is free, participants are selected competitively.

Contacts: Vicki Harder, Principal Investigator, University of Texas at El Paso, El Paso, Texas 79968 USA; Phone: (505) 589-9447; Fax: (505) 589-9448; E-mail: vharder@aol.com or Rebecca L. Dodge, Co-Investigator, University of Texas at El Paso, El Paso, Texas 79968 USA; Phone: 9015-747-5305; Fax: 915-747-7876; E-mail: dodge@geo.utep.edu

Pre- and In-service Earth Science Training Opportunity (PESTO)

<http://www.gcric.org/agci-home.html>

PESTO is an Earth system science teacher enhancement summer workshop offered by the Aspen Global Change Institute (AGCI) for K-12 teachers and undergraduate students pursuing a career in education. During the week-long workshop, participants explore current understanding in the interaction of land, air, water, biota and human activities as



they relate to global environmental change. Participants produce a portfolio of their work including the development of student activities. A variety of methods are employed including peer instruction, hands-on activities, presentation, discussion and an introduction to existing NASA and related educational materials and websites. A unique feature of the course is the interaction with visiting scientists from the Aspen Global Change Institute's summer interdisciplinary program for research scientists. Faculty include Richard Somerville; Professor, Scripps Institution of Oceanography, Milton McClare, Associate Professor and Director of In-service Education for Simon Fraser University; and John Katzenberger, Director, Aspen Global Change Institute. Course materials include NASA education products, AGCI's *Ground Truth Studies Teacher Handbook*, and *The Forgiving Air: Understanding Environmental Change*, by Richard Somerville. Partnering institutions in addition to NASA and AGCI are the University of Northern Colorado, Colorado Mountain College, Adams State College, and the Aspen Educational Research Foundation. Graduate and undergraduate credit is available (three credit hours).

AGCI is an independent non-profit organization. Its mission is to further the scientific understanding of Earth systems through interdisciplinary science seminars, publications, and educational programs about global environmental change science.

Tuition, course materials, lodging, and meals are provided for workshop participants.

Contact: Course applications for the 1998 and 1999 summer programs are available from Jenifer Blomquist, Aspen Global Change Institute, 100 East Francis, Aspen, CO 81611 USA; Phone: (970) 925 7376; Fax: (970) 925 7097; E-mail: jenifer@agci.org.

Pre-Service and In-Service Teacher Enhancement Using a Space Camera

Contact: Wallace Fowler, University of Texas Austin, Austin, TX 78759-5321 USA; Phone: (512) 471-3583; Fax: (512) 471-3585; E-mail: fowler@csr.utexas.edu

Undergraduate and Graduate

Goddard Institute for Space Studies — Institute on Climate and Planets

<http://icp.giss.nasa.gov/>

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round learning environment which extends NASA's climate research program from GISS to high school and college classrooms. Participating schools are dedicated to addressing New York State Learning Standards for Mathematics, Science, and Technology (based on the AAAS Project 2061), creating an advanced science learning environment for minority students, and providing them with access to professional and academic networks through which to pursue their interests in scientific discovery.

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Contact: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025 USA; Phone: (212) 678-5653; Fax: (212) 678-5552; E-mail: charris@giss.nasa.gov

Project NOVA

<http://www.eng.ua.edu/~nova>

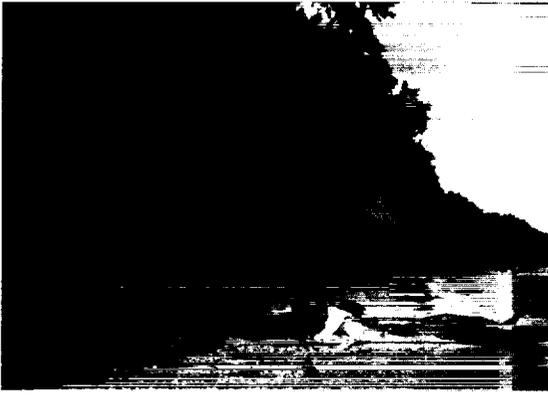
Project NOVA was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The Project NOVA consortium, consisting of the University of Alabama, Fayetteville State University and the University of Idaho, is working to produce enhanced scientific literacy for new teachers. This effort will be accomplished through the demonstration of an undergraduate science course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics and technology as a means of developing a new paradigm for educating teachers. Project NOVA invites the participation of science, engineering, technology, mathematics, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, Project NOVA will provide faculty with enhanced knowledge and skills to implement change in university courses.

Over a three-year period, beginning in 1996, the Project NOVA team will present a series of three-day workshops to interdisciplinary university teams. These universities will be eligible for small Implementation Planning Grants (up to \$30,000) to initiate change in science, mathematics, or

engineering courses for preparing K-12 teachers. In addition, the project is linking participants together through a world wide web server, which is providing the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

Faculty wishing to participate in a workshop are required to complete an application describing their commitment to developing interdisciplinary science, mathematics, and/or engineering courses for future teachers, and be selected. The interdisciplinary team must consist of faculty from two or more disciplines or colleges (one must be from a college of education) who demonstrate a willingness and ability to work together. A memorandum of understanding signed by the appropriate administrators of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

Contact: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280 USA; Phone: (205) 348-7304; Fax: (205) 348-4171; E-mail: mfreeman@coe.eng.ua.edu



Summer Faculty Fellowship Program

NASA's Education Division, Higher Education Branch, in cooperation with the American Society for Engineering Education (ASEE), awards summer fellowships to engineering and science educators. The Summer Faculty Fellowship Program is designed to further the professional knowledge of engineering and science faculty and NASA scientists and engineers, and contribute to ongoing research at NASA facilities. The program provides a good opportunity for faculty to establish contacts with NASA researchers and generally learn more about how to access the agency.

Those selected for participation receive a weekly stipend of \$1,000, plus travel expenses, and a relocation allowance. Fellows spend ten or eleven weeks working at a NASA Field Center on aeronautics or space-related research, including the Earth sciences. Their working experience is supplemented with enrichment activities, such as short courses, workshops, and seminars.

Participating faculty members must be U.S. citizens with teaching or research appointments in universities or colleges and have, preferably, two years experience. Interested persons are encouraged to obtain the program brochure for current research opportunities. Application deadline is January 15 with letters of appointment March 1.

Contact Information: American Society for Engineering Education (ASEE), 1818 N Street, NW, Suite 600, Washington, DC 20036 USA; Phone: (202) 331-3500

Systemic Change

Systemic change efforts focus on initiatives that incorporate Earth system science and global environmental change into state and local education systems. Through the U.S. Global Change Education State Teams, NASA is supporting state systemic change efforts in K-12 curricula. At the university level, NASA is supporting college-level curriculum development in Earth system science at universities across the country through the University-based Cooperative Program in Earth System Science Education (ESSE).

Elementary and Secondary

U.S. Global Change Education State Teams

The U.S. Global Change Education State Teams were originally formed in 1994 in 50 states, with the purpose of developing action plans and strategies to infuse global change science and issues into state curricula. The teams consist of classroom teachers, curriculum specialists, informal educators (e.g., museum and aquarium representatives), college faculty, and environmental scientists. This project is a major component of the U.S. Global Change Research Program's (USGCRP) education initiative.

In 1996, NASA and the Environmental Protection Agency (EPA) funded a total of 25 states' proposals for 2-year projects.

These projects include teacher-training workshops, curriculum development, and resource development, all focused on global environmental change. Descriptions of the projects are included, by state.

Contact: Ms. Nora Normandy, Education Program Manager, NASA Earth Science Enterprise, Code YP, Washington, DC 20546 USA; Phone: (202) 358-0871; Fax: (202) 358-2891; E-Mail: nora.normandy@hq.nasa.gov

Arkansas

A Clear View of the Future: Project Glass in the Classroom

The Arkansas Department of Education proposed to extend efforts begun with a planning grant received from the National Science Foundation. Through Project Glass, those monies facilitated the establishment of a statewide network of social studies and science teachers who have collaborated on the classroom application of global change environmental issues. Initial work was begun on units of study for secondary classrooms with technology as an essential part of the process.

The result of this extension and enhancement of Project Glass will be integrated units of study in global environmental change for secondary school students (7-12). Key components include collaborative work by teachers from social studies and science classrooms in developing the units, utilization of technology to facilitate the communication and research, involvement of a core group

of teachers through a project steering committee, and field tests of all proposed units. Once the units are in place, they will be disseminated through print and over the Internet. All units of study will be developed in agreement with the Arkansas Social Studies and Science Curriculum Frameworks, recently developed state documents which mirror work of the National Council for Social Studies and the National Science Teachers Association.

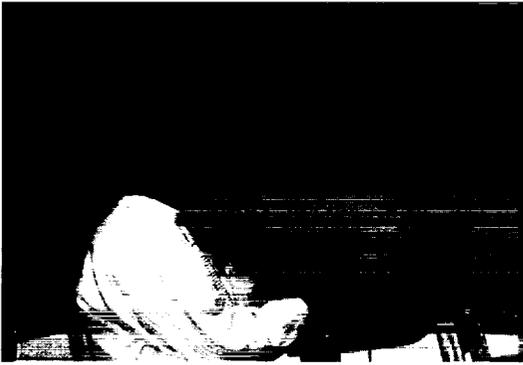
Contact: Barbara Patty, Arkansas Department of Education, 4 Capitol Mall, Room 104-A, Little Rock, AR 72201 USA; Phone: (501) 682-4558

Colorado

Global Change Education Grant for Colorado

The Colorado Global Change Education (CGCE) Team finds the optimal strategic plan for our state to be the integration of two existing statewide action plans (one in environmental education and one in education reform for public schools). The overarching goal of this project is to develop strategic linkages which will accomplish CGCE goals through cooperative planning and integrated action. Colorado is fortunate to already have in place several very active organizations working collaboratively for a unified environmental education approach.

The 1995 Colorado Environmental Education Master Plan (CEEMP), sponsored by the Colorado Alliance for Environmental Education (CAEE) is compatible and complementary to the goals of the Global Change Initiative. Currently,



the implementation phase of the CEEMP project is underway to develop a comprehensive network of EE program providers working to minimize duplication and fragmentation, to maximize the resources available, and to amplify the benefits and opportunities of environmental education. This amplification of the collective EE product through the broad goals outlined in the master plan is a ready-made blueprint for encouraging statewide systemic integration of global environmental perspectives in educational programming for both formal and informal settings.

Another important component is the systemic education reform initiative underway in Colorado, the heart of which is curriculum content standards. Now a state law, and adopted by the Colorado Department of Education, a standards-based educational system for public schools is already being implemented in six priority areas including science, math, geography, history, reading, and writing. Concepts of Global Change Education are prominent in the science and geography standards and well represented in the others. As the state's 176 school districts adopt the standards, so will they align their curriculum, instructional programs, assessment, and professional development.

In summary, this project seeks to capitalize on the opportunity of synthesizing CGCE planning initiatives and activities into CAEE's master plan and into CDE's curriculum content standards, and science and math systemic reforms, thus avoiding wasteful and needless duplication of effort,

and enhancing CGCE goals by integrating an established network and infrastructure.

Contact: Don Hollums, Colorado Department of Education, 201 E. Colfax, Denver, Colorado 80203-1799 USA; Phone: (303) 866-6787; Fax: (303) 866-6836; E-mail: hollums_d@cde.state.co.us

Connecticut

Connecticut Global Change Education Team Proposal

The State of Connecticut Global Environmental Change Education Team (CT Team) will be working on a statewide implementation program with the goal of integrating global environmental change education curricula and resources into the state's school systems. The program will take two years to implement.

This integration will utilize an existing statewide network of education programs, affiliations and cooperative arrangements which will include teachers, informal educators, and university faculty. The CT Team will work closely with the State Department of Education, the State Department of Environmental Protection and the Connecticut Academy of Math, Science, and Technology to link all global environmental change curriculum materials with the new national curriculum standards currently being implemented throughout the state through the education systemic change initiative.

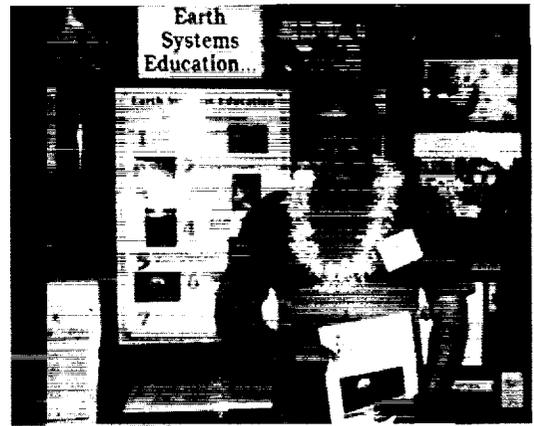
There will be a five phased approach to the implementation of the program. Phase 1 will consist of a one day forum where

200 teachers from across the state, representing all grade levels, will participate. The objectives of the forum will be to assess the current status of global environmental change education in Connecticut, assess the grade levels most appropriate for integration and identify a list of teachers willing to assist the CT Team in planning implementation strategy.

Phase 2 will consist of the CT Team and a select group of teachers reviewing existing, available resources on global environmental change and identify where these materials fit with the new national education standards. Once identified, the teachers and CT Team members will develop Global Environmental Change Education Resource Tool Kits. These kits will contain curricula, lesson plans, and resource materials and will be developed for the following grade level groups: K-2, 3-6, 7-8, 9-12. Teacher training institutes will be conducted during the third phase of the program. The institutes will increase the knowledge base of all participants and familiarize them with the Resource Tool Kits.

Phase 4 will be the actual school integration of the materials, where the teachers that were trained in the institutes will be required to conduct teacher workshops in their districts cross the state, for their colleagues. It is estimated that 560 teachers will be trained through this approach. Classroom implementation will follow.

The fifth and final phase of the program is evaluation and assessment. The focus of the evaluation will be the assessment of the



actual integration and use of global environmental change education curriculum materials and related teacher acquisition of knowledge.

Contact: Steven Fish, Connecticut Department of Environmental Protection, 79 Elm Street, Hartford, CT 06106 USA; Phone: (860) 424-3642, x2839; Fax: (860) 424-4058; E-mail: steve.fish@po.state.ct.us

Florida

Broadening and Sustaining Global Change Education in Florida

The Florida Initiative is in the midst of broadening and sustaining Global Change Education (GCE) by building upon the accomplishments of Florida's NSF Planning Grant and the creation of a Florida GCE website. The evolving website contains selected background information about Global Change and Florida's Global Change Education Initiative, Global Change Links, Global Change Topics, Florida Links, and information about how to join the project as either a teacher or a resource/mentor of a pilot project.

In addition, the Florida Initiative has been delivering presentations throughout Florida for the purpose of recruiting participants to a November 1997 match-making conference. At the conference, teachers and resource/mentors will team up to design school-based, resource/mentor-supported global change pilot

projects incorporating the following four criteria:

- 1) Students will engage in "real-world" science; i.e., they will engage in monitoring and investigation projects in field settings;
- 2) Students will enter their data into a computer database with networking capabilities;
- 3) Students will interact with members of the scientific community (locally or via the Internet); and
- 4) Students will interpret and use their data to perform "real-world" problem-solving activities (such as Service Learning Projects).

Project proposal applications will result in a limited number of invited conference participants. Business, Industry, and/or Agency resource/mentors are being recruited based on project proposal needs. Conference sessions will include, but not be limited to the following:

- Global Change content information (sustainability seems to be the most frequently requested topic), research protocol training, analysis of data training, telecommunications examples, service learning project design, funding source exploration, exhibits of related state-wide projects, exhibits of Florida school-based model projects, exhibits of related National/International projects.
- Post-Conference activities will include supporting and monitoring resulting Global Change Education pilot projects.

Contact: Sande Haynes, Friends of the Everglades, 38 Pompano Avenue, Key Largo, Florida 33037 USA; Phone: (305) 451-1582; E-mail: sobhaynes@aol.com

Hawaii

A Statewide Initiative on Global Change Education for Hawaii

The Hawaii Global Change Education Project is designed to develop a statewide systemic initiative in global change education. The project integrates global change education resources developed by NOAA/Sea Grant with curricula currently in use in the State's schools and informal educational institutions. Emphasis is to be placed on 1) training to strengthen educators' knowledge of global change concepts, and skills to effectively integrate these concepts into their educational programs; 2) developing a collection of modules to aid educators in incorporating global change content into existing curricula; and 3) development and maintenance of a WWW site devoted to global change education that will be a useful resource for both teachers and students.

A six day workshop held during the summer of 1996 trained a cadre of master teachers and informal educators from around the state, relating content knowledge and applications through presentations by scientists and participation in lab/demonstration activities focused on inquiry-based learning. Educators also evaluated and suggested improvements to



the Hawaii Sea Grant Global Change Education Home Page, piloted during the spring of 1996, and developed teaching materials which were tested during the 1996-97 school year. During the summer of 1997 cadre members are developing broader modules linking global change concepts to state and national performance standards and existing environmental education curricula in use in the state. Modules developed this summer will be field tested and incorporated into in-service trainings during the 1997-98 school year. A videoconference in spring 1998 will provide for an exchange among educators on integrating the teaching modules and general global change concepts into their classrooms and educational programs. This continuing process of testing and adaptation will produce a set of global change educational resources keyed to the State Content and Performance Standards, as well as a cadre of educators to continue the dissemination of resources beyond the project period.

Contacts: Scott Bogle, University of Hawaii Sea Grant Program, 1000 Pope Road, MSB #226, Honolulu, Hawaii 96822 USA; Phone: (808) 956-2861; Fax: (808) 956-2858; E-mail: bogle@hawaii.edu OR Colleen Murakami, Hawaii State Department Education/OASIS, 189 Lunalilo Home Road, 2nd Floor of Honolulu, HI 96825 USA; Phone: (808) 934-1348; Fax: (808) 548-5390; E-mail: colleen_murakami@notes.k12.hi.us

Idaho

A Blueprint for the Enhancement of Environmental Education in Idaho

Idaho intends to establish an Inter-agency Advisory Council (IAC) to develop, disseminate and integrate a set of standards for interdisciplinary environmental education programs to guide educators in all aspects of environmental education throughout the K-12 formal education system, in informal education where programs are conducted for a variety of audiences, and at the university and graduate level, especially to teacher training institutions and in-service programs. The project will formulate a plan for dissemination to all agencies, formal and informal educators, parents, and the interested public at large.

Plans are to take all necessary steps to ensure the adoption of these standards and master plan by the State Board of Education which will have the force and effect of law in all public education in Idaho. Following the models established by other states, the project will locate funding sources for implementation of the standards and master plan. Establishment of the IAC entails inviting the participation of a representative of natural resource and public land management agency and educational institutions. Interactions between members of the IAC will be strongly encouraged. Following a general meeting, the IAC will establish a steering

committee which will begin work on a strategic plan through the following series of steps:

- 1) Identify exemplary programs, leaders and projects.
- 2) Survey current levels of environmental education in Idaho, review environmental education documentation and history; examine other successful state programs and projects upon which to model our strategy.
- 3) Survey current usage and availability of computer technology among educators. Identify gaps.
- 4) Establish communication network and develop communication procedures for dissemination of projects, programs, and assessment processes through computer linkages.
- 5) Establish procedures for formative evaluation of the project. Begin development of assessment procedures.
- 6) Develop initial legislation for accomplishment of goals.
- 7) Re-visit and re-evaluate goals based on progress. Revise as needed.
- 8) Disseminate widely; encourage, support, and guide adoption by State Department of Education and State Legislature.

Contact: Chris Gertschen, Idaho Society for Energy and Environmental Education, Sawtooth Science Institute, PO Box 2, Sun Valley, ID 83353 USA; Phone: (208) 788-9686



Indiana

Global Change Education: Enhancing Teaching Capacity and Building Statewide Linkages In Indiana

This project will develop and implement a strategic action plan to help Indiana educators, both formal and informal, become more aware of global change issues and educational resources, be motivated to incorporate global change concepts in their curriculum/teaching, and forge linkages among educators, state agencies and non-governmental organizations. To accomplish these objectives, the state global change education team will

- 1) conduct a focused statewide survey;
- 2) create and maintain an accessible World Wide Web site as a source of information about global change education resources;
- 3) convene a workshop to build linkages;
- 4) conduct professional development sessions for teachers;
- 5) provide modest competitive curriculum development grants for formal and informal education;
- 6) present at the Governor's Conference on the Environment; and
- 7) continually monitor and evaluate the process.

Contact: Rich Block, Indianapolis Zoo, 1200 West Washington Street, Indianapolis, IN 46222 USA; Phone: (317) 630-2023; Fax: (317) 630-5153; E-mail: rblock@mail.indyzoo.com

Iowa

Project Earth Change (PEC)

PEC has begun to educate Iowans to take responsible action relative to global environmental changes. The objectives include formal and informal education and are designed to:

Formal — analyze and synthesize resources for classroom teachers, implement the use of resources and teaching strategies through professional development workshops, and enhance global environmental change education teaching skills of classroom teachers.

Informal — develop interdisciplinary activities which include an environmental action component, and implement the use of resources and teaching strategies through the training of trainers.

Iowa has an extended history of conservation/environmental education including the current Environmental Issues Instruction (eii) teacher enhancement program. The instructional model of the eii program has as its goal responsible environmental action resulting from a strong base of content and understanding of issue components. With the aid of an NSF planning grant, NASA support, and state grants, this model (Hungerford, 1985) has become the foundation for the following components of the PEC pilot program.

K-12 Formal Education:

- Instructional programs (e.g. Exploring Climate Change) which enhance teachers skills and resources to guide

students through an understanding of issues, content background (science, mathematics, geography), and responsible environmental action.

- **Informal Education:** Prototype activities are being developed which have the structure necessary for informal instruction, and to guide youth to understand issues, background (science, mathematics, geography), and responsible environmental action. Activities are being designed to meet national curriculum guidelines and will also be adaptable to other informal education programs.
- **Communication:** An internet system for communication among pilot teachers, students, and research scientists has been initiated.
- **Planning:** Using data from current activities and formal student evaluation, PEC's steering and planning committees will continue the process of statewide implementation. PEC will serve as a model for integration of science, mathematics, geography and other disciplines as a vehicle for global climate change education.

Contact: Carl W. Bollwinkel University of Northern Iowa Department of Teaching, Price Laboratory School, Cedar Falls, Iowa 50614-3593 USA; Phone: (319) 273-2783; Fax: (319) 273-6457; E-mail: bollwinkel@uni.edu



Kansas

A Public/Private Partnership for Environmental/Global Change Education (EGCE) In Kansas

By the year 2000, Kansas will have in place a comprehensive Environmental/Global Change Education (EGCE) program that will lead Kansas learners to environmental literacy. Through the efforts of the Kansas Association for Conservation and Environmental Education (KACEE) - formerly the Kansas Advisory Council for Environmental Education - this program will be a public/private partnership with a state infrastructure to integrate EGCE in formal and non-formal education programs. This will be accomplished by implementing the following objectives:

- 1) Develop and implement a Kansas action plan for EGCE through a process that involves all the major organizations that can have a positive impact in promoting and supporting effective EGCE. This process will strengthen the networks and coordinate public/private partnerships at the state, federal and local levels necessary to develop a meaningful strategic plan and coordinate and deliver effective EGCE programs.
- 2) Establish a network for EGCE coordination and assistance to ensure such activities are mutually supportive and complementary. KACEE will serve as the point of contact and referral for

the Kansas Board of Education on requests for assistance in EGCE. KACEE will work closely with the Kansas Cosmosphere and Space Center to explore opportunities to integrate EGCE into their efforts in teacher education.

- 3) Integrate EGCE in state curriculum standards. KACEE will work with the State Board of Education to integrate these objectives into voluntary state curriculum frameworks and to assist schools in doing the same. The State Board of Education is urging schools, through the Quality Performance Accreditation (QPA) process, to design educational programs that reflect the skills of teamwork, problem solving, critical thinking, and communicating.

- 4) Provide leadership as part of a public/private partnership in delivering EGCE programs for inservicing of teachers, training of preservice teachers, and nonformal education. KACEE will work to coordinate programs such as Project Learning Tree, Project WILD, Project WET and to integrate EGCE into the process.

- 5) Access federal and private funds not now available to Kansas either because lack of necessary infrastructure to seek them out or because of lack of awareness of their availability or potential to be secured.

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Kentucky

Leadership Development in Global Change Education - The Resource School Model

The Kentucky Environmental Education Council, a state agency charged with enhancing and coordinating environmental education throughout the Commonwealth, plans a systemic program of curriculum infusion and leadership development in global change education, K-12. The project would begin with two-week long summer institutes in which teams from 24 resource schools across the state would receive instruction in global change education techniques and concepts, as well as leadership and team building strategies. The teams would consist of two teachers, one parent, and a local school administrator. At the end of the institute, teams would participate in developing a strategy for infusing these concepts into curriculums in elementary, middle, and high schools. The Global Change Education Program would provide funding for these institutes.

In the five years following the institutes, each resource school would receive incentive funds provided by the Kentucky Environmental Education Council and private sector sources. The funds would be used to develop outstanding environmental education programs at each school. The receive the funds, each school team would agree to be an active resource for other schools in their area. Being a resource school would involve making presentations



to school-based councils, sponsoring an annual hands-on workshop, and providing technical assistance to other schools interested in developing an environmental education program. The Council would work with the resource schools to develop their outreach programs.

The goal of the project is not only to increase the amount of global change/environmental education taught in Kentucky, but to make it more uniform, rational, and systemic.

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Louisiana

Partners for Global Environmental Change Education

This two year project, developed by the Louisiana Global Environmental Change Education Team, will seek to develop a cadre of teacher teams that will be trained in Global Climate Change related materials. Training was conducted via two summer face-to-face workshops and on-line interaction. A school team concept will be employed whereby an identified science teacher will partner with a non-science teacher at his/her school. Preference will be given to science teachers who have demonstrated excellence in teaching of environmental education/science and who have successfully participated in the GLOBE project, one or more of the Louisiana State Systemic Initiatives programs, the National

Consortium for Environmental Education and Training Leadership Workshop, or who have worked on developing the environmental education benchmarks for the Louisiana State Science Framework. Teams will be from the elementary, middle, and high school levels. The first workshop will include training in selected curricula suitable for the appropriate grade level along with appropriate technology applications. The first year, each school team will receive a CBL panel/system with probes and a graphing calculator. During the second year teams will have the opportunity to purchase additional materials, that best suit their individual needs, that enhance their teaching of global climate issues. The second workshop will be held at a remote education center where teachers could do water quality testing, air monitoring, orienteering, and other activities using their equipment. At the second workshop, plans were made for sustaining the network and on-going evaluation. Participants are encouraged to share their knowledge at the building level, school district level, and at state and national meetings. An on-line bulletin board will be developed to connect all team members. An advisory panel, composed of individuals from a wide range of agencies, was charged with the responsibility of overseeing the execution of the project.

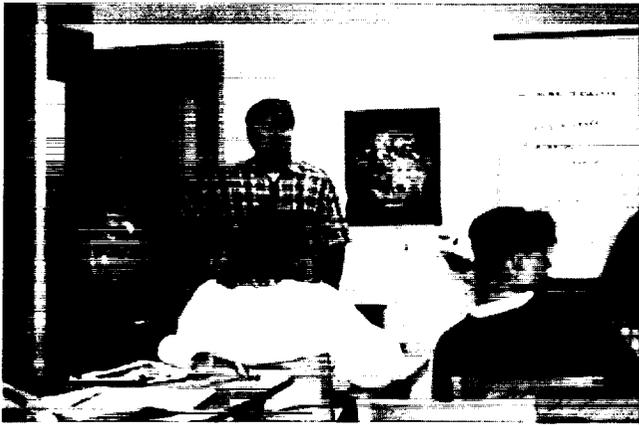
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Maine

Sustainable Forestry: Applying Maine's State Learning Results to a Model Global Environmental Change Education Program

This project is a continuation of a grant received by the Maine Geographic Alliance (MGA) from the National Science Foundation; that original grant was designed to encourage environmental education organizations in the state to align their K-12 professional development programs with the new state learning standards.

This current two-year grant will help MGA and other environmental education organizations in the state carry their work farther and implement some of their new learnings in professional development opportunities for Maine educators. MGA's 1996 summer institute will highlight environmental issues and begin the process of viewing issues through the new state learning results for approximately 25 K-12 teachers. During the 1996-97 academic year, environmental educators who have received training in work with the new state learning results will develop workshops for teachers on sustainable development issues related to Maine's natural resources. Participants in these workshops will be offered a framework for viewing the learning results through environmentalists' eyes, and workshop leaders will model activities and lessons that can be used by participants with students or with other



teachers in professional development settings.

During the summer of 1997, an institute focused totally on sustainable development issues facing Maine's economic and environmental future, especially the issues enmeshed in sustainable forestry practices and Maine's paper industry, will be held. It will be designed as an advanced institute, bringing back teachers who have been through other MGA summer institutes and who have received training in basic environmental and geographic field work skills and information; they will be joined by other teachers identified by other education organizations as ready for a more advanced learning experience in global change and sustainable development issues.

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Maryland

Maryland Global Change Education Project

The Maryland State Department of Education (MSDE), in cooperation with the Maryland Association for Environmental and Outdoor Education (MAEOE), has developed a project to improve global change education in Maryland schools. The project has five fundamental objectives.

Objective 1 focuses on what students should know and be able to do relative to global change. Representatives from a

cross-section of Maryland business, state, and federal agencies, higher education and public schools, and non-profit organizations would meet and focus, not so much as what should be taught, but on what students should know and do. These meetings will also serve to raise awareness of global change issues among participants, as well as prompt them to review their own global change education activities. The student outcomes, what students should know and do, would be used to guide other global change related education activities in Maryland in addition to focusing on this particular project.

Objectives 2 and 3 brings together educators and school system decision makers from across the state to review, and when required, write or develop necessary curriculum, instructional materials, resource materials, and training programs required to meeting student outcomes developed in Objective 1. During Objective 4, teams of teachers from schools and school systems are assembled for one week regional training sessions which are based on the work of Objectives 1, 2, and 3. Teachers who participate in these training sessions will become training leaders for future teacher training activities in their own school systems and training activities of Objective 5.

The goal of Objective 5 is to hold 10-15, 1 and 2 day teacher training workshops throughout Maryland. These would be conducted by selected teachers trained during Objective 4.

High school science and social studies would be the subject areas of principle focus for this project although some global

change related instructional units will be considered for middle school science and social studies as well. All project activities will reflect statewide school and student assessment projects that are major driving forces for educational change in Maryland. In addition, project activities will be designed to help students and schools meet the service learning high school graduation requirements (Maryland is the only state to have such a requirement) which present many valuable opportunities for students to put into action, in their own communities, what they have learned about global change.

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Massachusetts

Massachusetts Global Change Education Initiative—Incorporating Global Change Into Education Reform

The goals of the Massachusetts Global Change Education Initiative are to fuse global environmental change education with education reform efforts presently underway in the Commonwealth, and with environmental literacy benchmarks adopted by the state. The Global Environmental Education State Team will:

- 1) For a team of educator (including school teachers) and resource people; identify linkages between the issues of global change, the environmental



literacy benchmarks and the curriculum frameworks (part of education reform) in science, technology and mathematics.

2) Develop an inquiry-based model program which employs a transdisciplinary approach to the subject area. Analyze existing student knowledge about global change and the attitudes of students towards various strategies for cultural change.

3) School teacher members of the team will work with resource people to create a curriculum which will apply the frameworks model of inquiry learning through the asking of questions and seeking solutions to the issues of global change. The curriculum will be pilot tested and a formative evaluation of that model will be performed to ascertain the effectiveness of the curriculum.

4) The team will develop a kit for implementation of the curriculum, identify state and other resources available for implementation and long-term program support and will determine the best means for providing pre- and in-service teacher training programs.

5) The team will utilize dissemination vehicles including the Department of Education and the Executive Office of Environmental Affairs Home Pages and through video conferences and other telecommunications technologies.

Springfield Public Schools, through its high school for science and technology, and the Pollard Middle School, Needham, will

participate in the development and implementation of this pilot effort. Expansion of the pilot project is projected to begin in the first year with additional funding and with additional teachers and schools participating in the formative evaluation and implementation of the program.

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Minnesota

A Process for Exploring Global Environmental Issues

The Minnesota Global Environmental Change Education team identified a development and writing team that designed a workshop for teaching teachers how to use the exploring environmental issues process. The development team created global issue examples of how to use the process for secondary-level students. The workshop and materials demonstrate how using the process can help students achieve the Minnesota graduation standards. The second part of the workshop helps teachers access information through the Internet that helps them use the process to explore environmental issues.

The workshop was delivered to teams of Minnesota university teacher educators with their local secondary-level cooperative

teachers. Each college/secondary team is required to deliver a similar workshop to their local colleagues during the fall and winter of 1997-1998. Minnesota already has an active group of ten higher education institutions who are active in developing and delivering environmental education programs for pre-service and in-service teachers. This group of 10 forms the core of the workshop teams. In addition other teacher education institutions in Minnesota were invited to participate.

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Missouri

Missouri Conference on Environmental Education

The Conservation Federation of Missouri, in cooperating with the Missouri Department of Conservation and with input and support from the Missouri Department of Elementary and Secondary Education, Department of Natural Resources, Department of Agriculture and Missouri Geographic Alliance, will host a conference on Environmental Education. The conference will be open to teachers, members of environmental organizations, and the general public.

The conference goal is to promote the use of Missouri environmental education resources in implementing Missouri's Academic Standards for students. This will be accomplished through the presentation



of scholarly papers and research findings related to environmental education, workshop sessions where hands-on learning activities are demonstrated, and field studies in which participants gain first-hand environmental experiences. Statewide systematic integration of global environmental perspectives in education programming for both formal and informal settings will be encouraged, partly but not solely, throughout the conference.

Additional information will be provided through dissemination of conference proceedings that include environmental education research, learning activities, and sources of available environmental education resources. A toolbox - teacher resource kit - will be provided to assist teachers with implementation of standards related to activities in the classroom.

Conference follow-up will be a new dimension proposed for addition to the program. This will involve providing workshops and technical assistance to further educate teachers regarding how to integrate environmental education into the total curriculum to meet the Missouri Academic Standards. These services will be provided through the Conservation Federation of Missouri.

In addition, the Conservation Federation in conjunction with the cooperators, will initiate planning for an environmental education conference to be held in fall 1997.

Contact: D.K. Hirner, Conservation Federation of Missouri, 728 West Main, Jefferson City, MO 65102 USA; Phone: (573) 634-2322

New Hampshire

New Hampshire's State Plan for Global Change Environmental Education

The program intends to develop a broadly-based state team to support efforts to incorporate global change environmental education in at least six to ten elementary and middle schools in the next two years. Three existing programs in the state will receive some resources from the program and will be important members of the team. Planning will begin with selection of team members, some of whom will examine state standards to discover where global change environmental education can be inserted into the curriculum. Efforts of the team will include planning a 5-day course for teachers from cooperating schools in the summer of 1997 with a follow-up one-day meeting at the University sponsored by Sea Grant in the spring of 1998, to coincide with the American Women In Science exhibition held each year on the campus. Participating teachers will hold a teacher workshop for fellow teachers in the fall, following the summer course.

Supporting this effort will be the Global Change Environmental Education Resource Center in the Sea Grant offices which will be further developed as a research and distribution point for global change environmental education resources.

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New Jersey

Global Change Education—The New Jersey Initiative

The New Jersey initiative for global change education has been organized under the banner of Project ADD: Assemble, Develop, and Disseminate. These three elements should be understood as a system, the parts of which will support each other in the manner of positive feedback loops.

The Assemble element of the plan refers to the gathering and organizing of existing global change resources both human and material. These resources will be used in training activities and the materials will be housed at a central facility, the Center for Earth Science at Kean College, where they will be available to all interested educators.

The Develop element has a two fold purpose. One is to develop a network of people who have received training in global change education and who can then train others. To support this and other initiatives a global change education center will be organized to serve as a focal point for the dissemination of materials and information.

The Dissemination effort is a key component and will take a variety of forms including workshops, short courses, a web home page, and museum exhibits. Given the interdisciplinary and systems characteristics of global change education, we recognize the need to communicate with various individuals and groups.



Our view is that change is a basic characteristic of the earth system and operates across a variety of spatial and temporal scales. Our vision is that the understanding of the earth system and the changes that characterize it should become an important focus for education at all levels and that the interdisciplinary aspects of global change should receive emphasis.

To accomplish these goals and to achieve this vision, we have established a New Jersey Council for Global Change Education. This council has a two tier structure and includes the State Team supported by an advisory council.

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New York

Global Resource Environment Action Team (GREAT) of New York State

The key goal of GREAT is to provide all New York State Teachers with access to a trained core of regional mentors who will facilitate locating NASA data on global environmental change. We also provide classroom teachers, both formal and non-formal, with classroom activities and experience in accessing the NASA data. New York State Earth Science, Physics, and Math Mentor Network provides the regional mentors to present workshops and act as regional contact people for GREAT. The

mentors received training at a 1996 Summer Conference from Goddard Space Flight Center Aerospace Education Specialist. GREAT developed a computer program using pictures of NASA's web pages from the World Wide Web. Some of the links in the program were "active" to simulate moving between web locations. The program was presented using our laptop computers at workshops and conventions throughout New York State during the 1996-97 year.

At the Mentor Summer Conference in July 1997, we assessed the program, trained new mentors, updated the veteran mentors and shared successes and concerns. This fall GREAT will develop a new program simulating more sites of NASA Global Change data on the World Wide Web. Mentors will be able to present workshops using any or all of the following: 1) Our traveling laptop computer lab; 2) Computer labs available at local high schools, Teacher Centers, Colleges, Universities, or any site with computers networked together; and 3) Computer labs directly connected to the Web. The GREAT program will be available this year for either PC or Mac platforms.

Classroom activities, lab exercises, and hands-on activities will continue to be shared among the mentors and with workshop participants. We are planning to share these activities on our Mentor Web page (OMNI) or on a GREAT web page later this year. Program assessment will be made by evaluating the production of activities, the quality of those activities, the level of teacher participation and attendance, ongoing dialogue, and written evaluation by all participants.

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Oregon

Oregon Action Plan

In its first year, the Oregon Global Environmental Change Education Project offered workshops at conferences of the Oregon Science Teachers Association, the Environmental Education Association of Oregon, and the Oregon Indian Education Association, reaching nearly two hundred educators from a variety of levels and backgrounds. Our workshops have included expert speakers on subjects of global significance such as human population growth, climate and atmospheric change, and global change as viewed from the space shuttle. The project also featured master teachers who have offered lesson plans and materials from NASA, NOAA and other sources to help Oregon's educators incorporate concepts of global change into their curricula. A database was established of all Oregon educators who attended the workshops, and the project continues to keep in touch with them through CLEARING Magazine's Global Change Education Corner (the project newsletter). Oregon has also established a library of Global Change Education materials that is housed at the John Innskeep Environmental Learning Center at Clackamas Community College. In addition to support from NASA, USEPA, NOAA, and other agencies, the project has received considerable help from the



Oregon Department of Education and from the Hatfield Marine Sciences Center.

Future plans are to formally tabulate survey and evaluation results; revisit the same conferences and also to present at a joint conference of the Oregon Geographic Association and the Oregon Conference of Social Studies Teachers

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Rhode Island

Rhode Island Global Environmental Change Curriculum Implementation Program

The Office of Marine Education (OME) at the University of Rhode Island has developed a team of eleven middle school mentor teachers from a group of six Rhode Island school systems. This team of teachers has undergone intensive training to become global environmental change education specialists. During this program, the principal investigator and the mentor teachers will lead workshops for groups of teachers on teaching about global environmental change.

The workshops will take place at Rhode island's five regional collaboratives for mathematics and science education, the OME's annual teacher training program at URI, and through conferences sponsored by the Rhode island Environmental Educators Association.

The principal investigator will introduce teachers to global change issues and curriculum activities, demonstrate activities, and set up a plan to interact with them during the 1996/1997 school year. The mentor team, who have worked with the OME to develop a collection of over 80 curriculum activities on global change issues, will model team teaching and help the other teachers form action plans to integrate the activities into existing curricula.

Teachers will also be able to borrow activity kits which contain all the equipment and necessary instructions to conduct activities on global change topics. OME has prototype kits on all topics included in the collection of activities. Two teacher interns will be hired during the summer of 1996 to put together additional kits from the collection of activities for a total of 24 kits. Teachers may borrow them from OME or from each regional collaborative. Pre-service teachers and a graduate student assistant will visit the classrooms of newly trained teachers. These "visiting specialists" will conduct activities using the activity kits. This will serve the two-fold purpose of providing the teachers with classroom support and giving the pre-service and graduate student classroom experience.

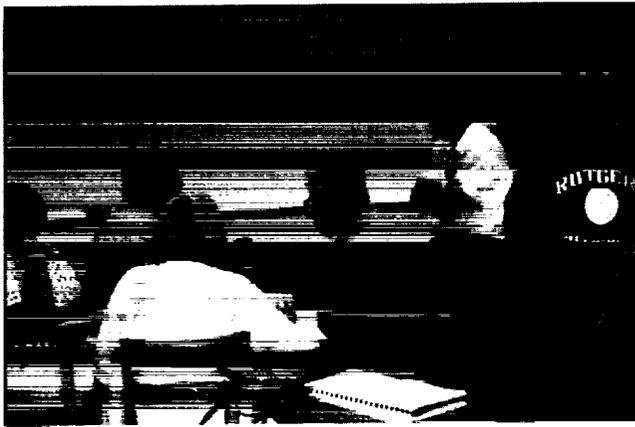
Contact: Gail Scocroft, University of Rhode Island, Narragansett, Rhode Island 02882 USA; Phone: (401) 874-6211; Fax: (401) 874-6486; E-mail: gailsco@gso.sun1.gso.uri.edu

South Carolina

Environmental Education Plan for South Carolina

The South Carolina Global Change Education Team will develop a renewed Environmental Education Plan for South Carolina and make Global Change Education an integral part of the plan. To accomplish this goal, the following objectives have been identified:

- 1) Provide leadership in and collaborate with existing Environmental Education groups to develop a renewed statewide environmental education plan. This plan will include Global Change Education as a major component.
- 2) Develop a plan to infuse Global Change Education activities into the S.C. Curriculum Frameworks, specifically targeting the Science, Math, and Social Studies Frameworks.
- 3) Develop and conduct a pilot Global Change Education Institute for middle and/or high school math, science, and social studies teachers. It will serve as a model for a similar institute for elementary teachers, and for a mini-institute for the public informal education settings (museums, parks, etc.).
- 4) Network with the S.C. State Systemic Initiative Hubs for the dissemination of information, training (teacher professional development), and resources to K-12 schools.



5) Develop sustainability by seeking renewed legislative support for the overall environmental education plan including global change education.

For the objectives that involve teaching activities or the development of an environmental education plan, the quality of the instructional activities will be assessed using standards set by the National Science Education Standards, Environmental Education Material for School Age Learners, Benchmarks for Science Literacy, Curriculum and Evaluation Standards for School Mathematics, and the South Carolina Curriculum Frameworks. They will emphasize factual data (research based), inquiry teaching methods, teaching for understanding (depth vs. breadth), gender and racial equity, an interdisciplinary approach, and activities that promote responsible life long behavior and decision making skills related to environmental decisions. Activities for the public (in informal education settings) will follow the same standards for quality.

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Utah

Utah Global Change Education

Recognizing that educated students are the key to future environmental responsible behavior and that teacher inservice is the

most effective way to reach large numbers of students, the Utah Global Change Education Grant capitalizes on systemic educational strengths to influence Utah citizens to "think globally and act locally."

Educators in Utah recently adopted a new Core Curriculum that significantly shifts the focus of science education. Based on the data from Project 2061 and the National Science Education Standards, we have written Intended Learning Outcomes for Grades K-12 requiring science literacy and process skills in addition to an understanding of science concepts. Because the Core is new, appropriate curriculum materials are very scarce. Our next step in educating citizens to "think globally and act locally" is to assemble curriculum materials which support the Core Curriculum. Simultaneously, we will begin training teachers to implement this curriculum. Grant monies will be used to attain the following specific goals:

- 1) Instructional implementation. We propose to put in place an elementary and secondary school curriculum which emphasizes global perspectives, intensifies environmental awareness and protection, and initiates local action.
- 2) Teacher Inservice. During 1997, we will begin the continuous process of inservicing Utah science teachers to use the developed materials. Workshops for elementary teachers and ninth grade teachers will be held to introduce the "think globally and act locally" curriculum and to help them implement the prepared materials.

3) Network. A systemic network is being created between teachers in the forty school districts, the State Office of Education, science education departments of the five major Utah universities, and many interested informal educational organizations that have a stake in global/environmental education.

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Wisconsin

Global Change Education for High School and Community/Technical College Educators

This project is enabling a cadre of Wisconsin educators (high school, community college and technical college) to teach others to understand scientific trends and concepts related to: 1) increases in greenhouse gases and changes in global climate; 2) ozone depletion and related increases in ultra-violet radiation; 3) degradation/depletion of resources; 4) declining biodiversity and ecosystem stability; and 5) human health and population dynamics.

Together with additional funding from the Wisconsin Environmental Education Board, five interdisciplinary workshops, each two and one-half days in length, are being offered at University of Wisconsin facilities around the state to provide for



maximum participation of school districts and colleges. These workshops are bringing together university and government agency scientists recognized as leaders in their fields of research, both in person and electronically, to equip Wisconsin educators with the most current content information on these topics. Armed with this information, workshop participants will learn to effectively communicate these complex subjects to high school and community/technical college level students. Each educator receives a resource packet of background materials on global change issues, as well as appropriate curriculum materials containing hands-on activities. Participants in turn make a commitment to infuse the concepts and activities utilized in the workshop into the courses they teach within the next year.

The investigators are also identifying and reviewing available educational materials on global change topics. They will select those most appropriate for use in teaching these subjects to high school and community college students. A resource list of these materials will be compiled for distribution to all workshop participants. Through a cooperative agreement, educators in neighboring states will receive this list of materials appropriate to high school/community college level in exchange for similar lists for elementary and middle school students.

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Wyoming

A Project to Develop, Refine and Implement Global Change Education Curriculum Materials (K-12) Primarily for Wyoming Schools

In Wyoming, a Statewide Integrated Conservation Education Program (SICEP) provides a model and ideal opportunity to implement Global Change Education (GCE) into all grades. This project will help incorporate CGE materials into SICEP through the following components.

- 1) University of Wyoming (UW) Summer Rocky Mountain Institute for Environmental Education - a workshop incorporating GCE materials into an existing model - Wild, Wonderful Wyoming manual. This one-week workshop offers UW graduate credit. Participants will learn about GCE from scientists and from curriculum materials they will take back to use in their classrooms.
- 2) Compiling NASA Materials - the initiation of compiling and analyzing NASA materials and information concerning GCE from the perspective of how they may be used in grades K-12.
- 3) Sponsorship of Three Workshops - NASA becomes a partner with the Wild, Wonderful Wyoming sponsors in presenting three one-day workshops on environmental education including global change. These workshops will

be offered for UW graduate credit and re-certification credit for teachers. Natural resource management personnel will also attend these workshops.

4) Meeting at Teton Science School to form a Strategic Plan for Implementing Global Change Education into Rocky Mountain School Curricula - a two-day conference at Teton Science School will bring together Global Change Education Teams from Wyoming and other Rocky Mountain states to develop a strategic plan for Global Change Education that will help network the Rocky Mountain states and help link them to the national effort.

5) Earth System Science Internet Project - this cooperative and complementary effort with the Wyoming Planetary and Space Science Center's K-12 outreach program will provide linkages to problem-based student exchange of data, images, and information.

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Undergraduate

University-based Cooperative Program in Earth System Science Education (ESSE)

<http://www.usra.edu/esse/ESSE.html>

The ESSE program consists of faculty from 44 U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education.

Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level

course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments, and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, involving visiting faculty and scientists from other participating universities and from NASA Centers.

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Curriculum Support

Curriculum support includes the development, use, and distribution of science, mathematics, and technology instructional products and curriculum based upon the Earth Science Enterprise's unique mission and results. These activities include support for elementary through college-level curricula and focuses on an interdisciplinary approach that supports national education standards. A listing of specific Earth Science Enterprise education products and how to obtain them is included in the section titled Resources (page 54). This section provides information on NASA-sponsored curriculum development and support projects.

Elementary and Secondary

Consortium for the Application of Space Data to Education (CASDE)

<http://www.casde.unl.edu/casde.html>

CASDE was created to provide mechanisms to integrate NASA's extensive data holdings and advanced information system technologies into education. The CASDE team developed the concept of *Virtual America* that has become the project's organizing and integrating concept. *Virtual America* includes: 1) images acquired by satellites and aircraft; 2) educational resources such

as guides, sample lessons, data and image descriptions, etc.; 3) analysis and demonstration tools; and 4) methods and standards for labeling, cataloging and archiving. The first component of *Virtual America* is *Virtual Nebraska*, an archive of digital space and aerial photography, real-time satellite imagery, tutorials, and lessons that educators, students, and resource managers can explore via the World Wide Web and CD-ROM.

CASDE has developed new technology in meeting its goals. The DataSlate allows users to explore essentially infinite datasets and to simultaneously compare co-registered and geo-referenced datasets. For example, the user may view a scene simultaneously in infrared and visible wavelengths or view a city as it appeared in 1938 and 1988. An online Remote Renderer is available in prototype form, which enables users to create three dimensional images and "fly-overs" of satellite imagery, working over the World Wide Web. Virtual Reality Modeling Language (VRML) is being explored to allow users and participants to explore space-based data in a realistic, immersive environment.

Contacts: Arthur I. Zygielbaum, Jet Propulsion Laboratory, 4800 Oak Grove Dr., M/S 306-416, 4800 Oak Grove Dr., Pasadena, CA 91109, USA; E-mail: aiz@ewok.jpl.nasa.gov or Don Rundquist, University of Nebraska - Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517, USA; E-mail: dr1000@tan.unl.edu

Discover Earth

<http://www.strategies.org>

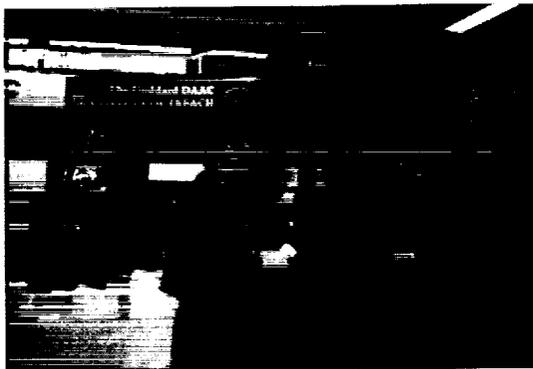
Discover Earth is a NASA-sponsored project, conducted by the Institute for Global Environmental Strategies (IGES), for exceptional teachers of grades 5-12 who want to expand their knowledge of the Earth system and prepare to become master teachers who promote Earth system science in their own schools, counties, and throughout their state. Participating teachers work with scientists and other educators during a two-week summer workshop to:

- enhance their understanding of the Earth as an integrated system;
- enhance their interdisciplinary science knowledge; and
- develop materials for their own classrooms and NASA publication.

Participants don't need to be science experts, but they do need to be willing to explore sophisticated content. Datasets and on-line resources will be used to enable an inquiry-based approach.

Discover Earth is an IGES collaboration with the Earth System Science Center of The Pennsylvania State University and the Department of Meteorology of the University of Maryland, College Park.

Teachers from the following states are invited to apply: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and Washington, DC. Course and classroom materials, accommodations, travel costs, and daily



expenses are provided. Participants will receive \$500 honorarium upon successful completion of the workshop. Each summer, Discover Earth examines different topics related to the key issues of global climate change; the 1998 workshop will be held in July, at the University of Maryland, College Park and will focus on the following topics: overview of the Earth system; oceans, circulation, productivity, air-sea exchange; ice sheets, polar and alpine glaciers, seasonal snow; sources of information; and student investigations/classroom activities. Discover Earth applications and education materials are available at IGES' WWW site.

Contact Information: Colleen Steele, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201 USA; Phone: (703) 875-8634; Fax: (703) 875-8635; E-mail: colleen_steele@strategies.org

Exploring the Environment Curricular Materials

<http://www.cotf.edu/ete>

Through a cooperative agreement with NASA Goddard Space Flight Center, the NASA Classroom of the Future has developed a Web site called Exploring the Environment. The problem-based modules address authentic worldwide environmental dilemmas. Teachers and students are trained online in the use of imaging software (NIH Image) so they can use NASA's view from space to observe biological, chemical, geological, and

physical changes occurring over enormous portions of the earth. Seventeen learning modules include hurricane tracking, predicting the global impact of a volcanic eruption, investigating the shrinking habitat of the mountain gorillas in Rwanda, and examining issues and images of the Amazonian Rainforest. Recent additions to ETE deal with El Niño, ozone depletion, and the global carbon budget. ETE features problem-based learning and connections to Earth System Science.

Contact Information: Robert Myers, NASA Classroom of the Future, Wheeling Jesuit College, Wheeling, WV 26003 USA; Phone: (304) 243-2368; FAX: (304) 243-2497; E-mail: bmyers@cof.edu

Forces of Change

Forces of Change is a comprehensive program being developed by the Smithsonian's National Museum of Natural History, through funding from NASA, to explain the geological, environmental, and historical processes that have shaped our world. It will consist of exhibits, publications, interactive computer programs, lectures, and classroom courses for all educational levels.

The cornerstone of the Forces of Change Program is an exhibit in the Museum of Natural History scheduled to open in the year 2000. The 10,000 square foot display will examine the forces of change that have shaped and sustained the Earth since the beginning of geologic time. The goal of the exhibit will be to inform visitors about the history and present condition of our environment as the world prepares to enter the 21st century.

Forces of Change will provide that information through a series of carefully-selected regional case studies. By examining these complex processes of change in a series of smaller systems, the public will better understand what is happening across the globe. The five regional studies that will form the scientific core of Forces of Change are Antarctica, the North American Prairies, Hawaii, the Chesapeake Bay, and Amazonia.

In addition to the exhibit, Forces of Change will be available in a variety of formats—videos, CD-ROMs, and posters—for use in classrooms, municipal buildings, malls, and airports. It is also anticipated that traveling versions will be developed and booked by SITES (The Smithsonian Institution Traveling Exhibition Service). Forces of Change is also the title of a book to be published by the NMNH and National Geographic in conjunction with the exhibit.

Contact: Barbara Stauffer, Smithsonian Institution, National Museum of Natural History, MRC: 101, Washington, DC 20560 USA; Phone: (202) 357-2377; Fax: (202) 786-2567; E-mail: stauffer.barbara@nmnh.si.edu

The Gaia Crossroads Project

<http://www.bigelow.org>

The Gaia Crossroads project is an innovative program using satellite remote sensing in K-12 classrooms. This progressive program captures the interest of elementary students and strives to sustain their interest through high school. Using the imagery provided, students are able to



study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage—the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support.

The Gaia Crossroads Project's long-range plan is to: a) Develop and publish materials for teachers and students; b) Expand the project to include public libraries in towns where the project is conducted in schools; c) Develop new strands (i.e., geographic information systems; coastal processes, estuaries, inland waterways; and conducting local research projects; d) Produce a series of CD-ROMS containing images and public domain software, documentation, and tutorials; e) Provide a full range of educational opportunities for teachers including a national training conference; f) Sustain and expand the project while providing ongoing teacher support; g) Set up an advisory council.

The Gaia Crossroads Project Teachers Guidebook for Using Satellite Imagery in the Classroom and Community will be available in 1998. It contains a remote-sensing primer, hands-on tutorials, information on educational setup, teaching resources, and over sixty activities written by teachers participating in the Gaia Crossroads Project.

Contact: Cynthia B. Erickson, Project Co-Director, The Gaia Crossroads Project, Bigelow Laboratory for Ocean Sciences, P.O. Box 475, McKown Point, West Boothbay Harbor, ME 04575-0475 USA; Phone: (207) 633-9600; Fax: (207) 633-9641; E-mail: gaiaxroads@bigelow.org

GSFC Earth Sciences Directorate Scientific and Educational Endeavors (SEE)

<http://see.gsfc.nasa.gov/>

SEE focuses on enabling the use of NASA Earth science information and data for education. This program develops educational products for high school and undergraduate educators and for students at these levels. It also encourages use of NASA's knowledge products in existing museums and interpretive centers and works to build partnerships between employees and groups within GSFC, and organizations and individuals involved in formal and informal education throughout the U.S. to jointly produce useful educational and public awareness materials that utilize NASA's Earth science knowledge and expertise.

Contacts: Blanche Meeson, NASA Goddard Space Flight Center, Earth Sciences Directorate, Code 900 Greenbelt, MD 20771 USA; E-mail: bmeeson@see.gsfc.nasa.gov or Carla Evans, Goddard Space Flight Center, Earth Sciences Directorate, Code 900 Greenbelt, MD 20771 USA; E-mail: cevens@see.gsfc.nasa.gov

Goddard Institute for Space Studies — Institute on Climate and Planets

<http://icp.giss.nasa.gov/>

The Institute on Climate and Planets (ICP) is a collaboration between NASA Goddard Institute for Space Studies (GISS), the City University of New York Alliance for Minority Participation, and the New York City Public Schools, which allows educators and science practitioners to form an ICP Lead and Partner School Research Network. The key goal of the ICP is to create a productive and stimulating year-round learning environment which extends NASA's climate research program from GISS to high school and college classrooms. Participating schools are dedicated to addressing New York State Learning Standards for Mathematics, Science, and Technology (based on the AAAS Project 2061), creating an advanced science learning environment for minority students, and providing them with access to professional and academic networks through which to pursue their interests in scientific discovery.

The intensive summer ICP program held at NASA GISS, and the academic year workshops conducted by faculty at ICP Lead Schools increase the capability of students and teaching faculty to establish satellite research programs on their campuses.

The result is varied education-level science teams that engage scientists, educators and students in a sustained,



research-driven dialogue. This dialogue can make a significant contribution toward addressing recent calls for national and state science standards. With the support of the NASA Minority University-Space Interdisciplinary Network (MU-SPIN), the school research network is gaining the technical competence and resources needed to contribute to on-going climate research projects. One of the newest venues for this contribution is via the newly-created ICP Web site's Virtual Research Institute. Currently, this network is comprised of six junior and senior colleges and six secondary schools in the New York City area. It is expected that two colleges and three secondary schools will join the network this year.

Communication and public education about the research and education outcomes of the ICP are the collective responsibility of students, faculty, and scientists. Presentations are made annually at professional meetings, academic competitions, local conferences, and in a small number of publications. Students also organize a Saturday Space Quest program for elementary school students, as well as a Paths to Discovery Seminar Series to engage their peers in a dialogue with science leaders about global climate change. The faculty's main contribution to ICP public education is by developing curriculum motivated by their research and field-testing in core science courses and research classes. Faculty are also working with scientists to develop an Earth Climate curriculum based on their research experiences and projects.

Contact: Carolyn Harris, NASA
Goddard Institute for Space Studies, 2880
Broadway, New York, NY 10025 USA;
Phone: (212) 678-5653; Fax: (212) 678-
5552; E-mail: charris@giss.nasa.gov

Goddard Space Flight Center Earth System Science Education Project (GESSEP) — Earth System Science Investigations Development

<http://hpcc-k12.gsfc.nasa.gov/gessep/>

Twenty Earth and environmental science teachers, selected from among the most outstanding teachers in the Maryland Ambassador Programs, are identifying and developing Earth System Science investigations, with technical assistance from NASA Earth scientists. These science learning investigations will be targeted for grades 5-8 and 9-12 and accessible through a NASA Internet site. As each investigation is written, it will be put on line in its "under construction" state for review.

The Maryland Ambassador Program began in the Summer of 1994 and continued through the end of the 1996 school year. Teams of Maryland middle and high school science teachers participated in this program, which was designed to help the teachers enhance their teaching and to serve as ambassadors to other teachers and to their local school district.

During their four-week summer session at Goddard Space Flight Center and at the University of Maryland, the Ambassadors received training in: gathering data by satellites to monitor conditions on Earth; the Maryland environment; use of the Internet; the integrated sciences of NASA's Earth Science Enterprise; and the use of computers to enhance teaching. Sixty-five teachers completed the Ambassador Program from across Maryland.

Contact: Stephen Gilligan, Principal Investigator, Phone: (301) 283-4338; E-mail: charles1@mail.ameritel.net; or Vern Smith, Co-Investigator, Phone: (301) 286-1977; vern@aesp.nasa.okstate.gov

TOPEX/POSEIDON Project Educational Outreach

<http://topex-www.jpl.nasa.gov>

Jointly sponsored by NASA and the French Space Agency (CNES), TOPEX/POSEIDON has continuously surveyed the oceans' surface currents with radar altimeters since launch in 1992 and is expected to continue to collect data through at least September 1998.

Scientists are using TOPEX/POSEIDON satellite data to learn how heat from the Sun is transported around the globe by ocean circulation patterns. Researchers now have an improved understanding of the role of the oceans in controlling seasonal variations and longer-term climate changes. TOPEX/POSEIDON data are also used for operational purposes, such as monitoring eddies and their impact on human activities and marine life.



The TOPEX/POSEIDON Project develops and provides a wide variety of materials to K-13 educators and students in hard-copy, electronic, and video formats. TOPEX/Poseidon satellite data are regularly posted on the World Wide Web, a few hours to days after acquisition, that can be used to help educators and students learn about our global oceans and climate.

Contact: Annette deCharon, Earth Science Flight Projects, Jet Propulsion Laboratory, M/S 264-686, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; Phone: (818) 354-4887; Fax: (818) 354-0368; E-Mail: topex@jpl.nasa.gov

Community College and Undergraduate

An Associate of Arts in Community Colleges for Training in Earth Science (ACTES)

<http://www.smccd.cc.ca.us/smccd/csm/actes/actes.html>

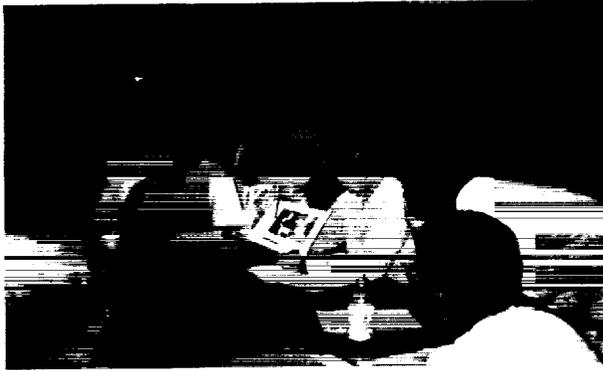
ACTES is a collaboration between the College of San Mateo (CSM) and NASA Ames Research Center, with three major goals. The first is implementing remote-sensing data use in a broad range of community college courses. Second, is creating curriculum modules and classes that are transportable to other community colleges via the World Wide Web (WWW). Third, at the end of the three-year project, a WWW server will have been established that will be an ongoing source of data and curriculum materials to other community colleges.

A sequence of five courses has been established at CSM and approved for community colleges state-wide for students wishing to earn an AA degree in this area of expertise. The titles for the courses are: Introduction to Earth Systems Analysis; Spatial Analysis in Geographic Information; GPS, GIS and Image Processing; Remote Sensing Technology and Processing; and Laboratory Practicum.

The result of this curriculum will be hands-on learning for students whether they are at a two-year college for an AA degree, retraining to improve their job skills, taking classes to satisfy requirements for four-year colleges, or any combination of these options. The expectation is that these students will be able to continue their education in remote sensing/Geographic Information Systems (GIS) at a senior college, move into entry level positions at local companies where remote-sensing and GIS technologies are used, or have valuable skills to append to their resumes.

At the completion of the project, colleges throughout the nation will be able to download materials from the ACTES WWW site and use them for their own related course work and programs. These materials will include course outlines, classroom exercises, individual lessons, and supporting graphics and images.

Contacts: Ken Kennedy, Department of Political Science, College of San Mateo, 1700 W. Hillsdale Blvd., San Mateo, California, 94402 USA; Phone: (415) 574-6656; Fax: (415) 574-6680; E-mail: kennedy@smccd.cc.ca.us or J. W. Skiles, SETI Institute, Mail Stop 239-20, NASA Ames Research Center, Moffett Field, California 94035-1000 USA; Phone: (650) 604-3614; Fax: (650) 604-1088; E-mail: jskiles@mail.arc.nasa.gov



Remote Sensing Core Curriculum

<http://www.umbc.edu/rsc>

The Remote Sensing Core Curriculum (RSCC), sponsored by NASA, the National Center for Geographic Information Analysis (NCGIA) and the American Society for Photogrammetry and Remote Sensing (ASPRS) is a college-level education program developed in cooperation with international experts and businesses to ensure an authoritative and substantive curriculum in remote sensing. The curriculum includes a series of lecture outlines, accompanied by self-contained laboratory exercises developed to support the advancing technologies of remote sensing and its integration with spatial information systems. Digital data sets from existing and planned satellite missions will enhance the understanding of advanced concepts. The RSCC design will ensure full access to data sets, operating software, and lecture materials via the RSCC home page. The lecture series will initially be organized under four volumes:

Volume 1: Airphoto Interpretation and Photogrammetry;

Volume 2: Overview of Remote Sensing of the Environment;

Volume 3: Introductory Digital Image Processing; and

Volume 4. Remote-Sensing Applications.

Contact: Tim Foresman, University of Maryland, Baltimore County (UMBC), Department of Geography, 1000 Hilltop Circle, Baltimore, Maryland 21250 USA; Phone: (410) 455-3149/3847; Fax: (410) 455-1056

University-Based Cooperative Program In Earth System Science Education (ESSE)

<http://www.usra.edu/esse/ESSE.html>

The ESSE program consists of faculty from 44 U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education.

Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a

scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments, and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, involving visiting faculty and scientists from other participating universities and from NASA Centers.

Contacts: Donald Johnson, Phone: (608) 262-2538, E-mail: donj@ssec.wisc.edu; Michael Kalb, Phone: (301) 805-8396, E-mail: mkalb@gvsp.usra.edu; or Martin Ruzek, Phone: (414) 732-4514, E-mail: ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706 USA

Resources

Earth Science Enterprise Education Products

A listing of ESE education materials is provided in this section. Unless noted, the following materials are available through the NASA Educator Resource Center (ERC) Network. Many products are also noted as available over the Internet or from NASA Central Operation of Resources for Educators (http://spacelink.nasa.gov/CORE/CORE_Home.html), which distributes materials to teachers at cost, nationally and internationally. Please see page 64 for information about NASA CORE and page 65 for information about the NASA ERCs.

Teachers' Guides/ Classroom Activities

Elementary

Our Mission to Planet Earth: A Guide to Teaching Earth System Science (EP-292), 1994, 37p., provides hands-on activities and information related to studying the Earth system. Its primary goal is for children to become familiar with the concept of cycles and to learn that some human activities can cause changes in their environment.
Recommended level: grades K-3.

Ground Truth Studies Teacher Handbook, 2nd Edition, 1995, 144p., was developed in cooperation with NASA and designed to provide teachers with an introduction to global environmental change, remote sensing and ground

truthing. It includes primers on global change and remote sensing, 22 student activities, glossary, resources, bibliography, and five high-quality color plates of Landsat and aerial color infra-red photography. Cost is \$19.95 plus shipping and handling, bulk discounts available.

To order contact Jenifer Blomquist (jenifer@agci.org), Aspen Global Change Institute, 100 East Francis, Aspen CO 81611 USA; Phone: (970) 925-7376; Fax: (970) 925-7097. The Handbook will also be available at the following website: <http://www.gcrio.org/agci-home.html>.
Recommended level: grades K-12.

Middle School

ATLAS 2 Teacher's Guide with Activities: Atmospheric Detectives (EP285/11-92), 1992, 20p., probes the connection between the activities of scientists and researchers and the observable world of weather and climate. The guide is set up as a mystery with cases, clues, procedures, and questions. Based upon the ATLAS 1 and ATLAS 2 Space Shuttle experiments.
Recommended level: grades 6-8.

Glacier Power, 1997, CD-ROM, is a curriculum supplement module on the topic of glaciers that was developed in cooperation with NASA by the Alaska Synthetic Aperture Radar Facility (ASF) at the University of Alaska, Fairbanks and in cooperation with the Fairbanks North Star Borough School District and the University of Alaska Fairbanks, School of Education. It has been formatted to be used on the

Macintosh by an Internet browser which will enable students in many rural areas who use the CD-ROM to also become acquainted with internet functions as their schools continue progress to come "on-line." The guide includes information on glaciers and their importance to climate studies; lesson plans; student review exercises, activities, and projects; and resources such as glacier imagery, satellite imagery, illustrations, diagrams, and more. Available online at: <http://www.asf.alaska.edu:2222/> or on CD-ROM from NASA CORE in 1998.
Recommended level: grades 4-6.

Ground Truth Studies Teacher Handbook, 2nd Edition, 1995, 144p., was developed in cooperation with NASA and designed to provide teachers with an introduction to global environmental change, remote sensing and ground truthing. It includes primers on global change and remote sensing, 22 student activities, glossary, resources, bibliography, and five high-quality color plates of Landsat and aerial color infra-red photography. Cost is \$19.95 plus shipping and handling, bulk discounts available.

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Recommended level: grades K-12.

Resources

Looking at Earth from Space: Glossary of Terms (EP-302), 1994, 76 p., includes science and technology terms relevant to Earth science, remote sensing and direct readout. Available in print or online at http://eosps.gsf.nasa.gov/Earth_Glossary/Intro.html.
Recommended level: grades 5-12.

Looking at Earth from Space: Teacher's Guide with Activities for Earth and Space Science (EP-303), 1995, 342 p., will enable teachers to expand their knowledge of the atmosphere, common weather patterns, and remote sensing. Also included are 16 classroom activities, as well as sections on resources and setting up a satellite ground station.
Recommended level: grades 5-12.

Spaceborne Imaging Radar: Seeing the Earth in a New Way (CORE # 400.0-75, SIR-CED03), 1996, CD-ROM, is based upon radar images generated by the Shuttle Imaging Radar (SIR)-C instrument flown on the Space Shuttle in April and October 1994. The disc contains a teachers' resource guide, presentation materials, lesson guides (including activities for students), radar images, hand-held photographs taken by shuttle astronauts, digitized location and topographic maps, ground photographs, video clips, software for image display and analysis.

Available from NASA CORE (\$12, plus \$6.00 shipping within the U.S.) in Macintosh or Windows formats; a companion website is at: [http://](http://southport.jpl.nasa.gov/companion)

southport.jpl.nasa.gov/companion.
Recommended level: grades 5-12, undergraduate.

High School

Arctic Observatory/Sea Ice in the Polar Regions was developed by the Consortium for International Earth Science Information Network (CIESIN) through sponsorship by the Office of Naval Research and in cooperation with NASA GSFC. The Arctic Observatory includes a teacher's guide and interactively deals with Arctic phenomena and processes, allowing students to ask and answer questions about interrelationships between several physical aspects of the Arctic system. *Sea Ice in the Polar Regions* is a presentation by NASA GSFC scientist Claire Parkinson, which describes sea ice classification, observation and climate impacts.

Both resources will be available on one CD-ROM from NASA CORE in 1998; they can also be downloaded from: http://www.usra.edu/prog_inst/esse/learnmod.html.
Recommended level: high school-adult.

Geomorphology from Space, an out-of-print, 1986 NASA classic publication by Nick Short, Sr. and Robert W. Blair, Jr., is now available on CD-ROM and on the World Wide Web. This publication is designed for use by the remote-sensing science and educational communities to study landforms and landscapes. It contains a gallery of 237 color, and black and white plates of space imagery primarily of the Earth, each treating a geographic

region where a particular landform theme is exemplified. Each image is paired with a detailed scientific description of the features in the image, some images are accompanied by line drawings, locator maps, geologic maps, and on-the-ground photographs of the landform.

Available on CD-ROM from NASA CORE in 1998 or online at: http://daac.gsf.nasa.gov/DAAC_DOCS/daac_ed.html.
Recommended level: high school-adult.

Global Systems Science, 1998, consists of interdisciplinary course materials developed by the Lawrence Hall of Science, through funding from the Department of Energy. The first two guides in the series, *A New World View* and *Changing Climate*, will be available in late 1998 from NASA CORE.
Recommended level: high school.

Ground Truth Studies Teacher Handbook, 2nd Edition, 1995, 144p., was developed in cooperation with NASA and designed to provide teachers with an introduction to global environmental change, remote sensing and ground truthing. It includes primers on global change and remote sensing, 22 student activities, glossary, resources, bibliography, and five high-quality color plates of Landsat and aerial color infra-red photography. Cost is \$19.95 plus shipping and handling, bulk discounts available.

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Fax: (970) 925-7097. Beginning in December 1997, the Handbook will also be available at the following website: <http://www.gcrio.org/agci-home.html>.
Recommended level: grades K-12.

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Available from NASA CORE (\$12, plus \$6.00 shipping within the U.S.) in Macintosh or Windows formats; a companion website is at: <http://southport.jpl.nasa.gov/companion>.
Recommended level: grades 5-12, undergraduate.

Lithographs with Classroom Activities

Earth View (HqL-331)

First Image of the Global Biosphere (HqL-325)

Nimbus-7 TOMS Images: The Eight Marches (HqL-366)

Nimbus-7 Ocean Ice Maps (HqL-319.1)

TOMS Ozone - Difference from Climatology (HqL-371)

Understanding Our Changing Planet: NASA's Mission to Planet Earth (HqL-430)

Water is a Force of Change (HqL-401)

NASA Facts

NASA Facts are educational brochures that provide general information and background on NASA-related missions, research topics, and activities. A series of NASA Earth Science Enterprise-related NASA Facts was produced in an effort to educate the general public concerning some of the issues and the natural phenomena that scientists are studying using NASA Earth science data. The series is available online at: <http://eosps0.gsfc.nasa.gov>.

Ozone: What it is, and why do we care about it? - NF-198, December 1993

Clouds and the Energy Cycle - NF-207, January 1994

Polar Ice - NF-212, February 1994

El Niño - NF-211, February 1994

Volcanoes and Global Climate Change, - NF-220, March 1994

Global Warming - NF-222, March 1994

Biosphere - NF-223, March 1994

Posters

Earth's Changing Atmosphere: Investigating its Mysteries (WED-114/9-94), 1994. The back of the poster is laid out with nine standard-sized pages, which provide information and activities related to studying Earth's atmosphere, including atmospheric gases, ozone, solar cycles, tracking short-term weather changes, and resources for educators.
Recommended level: grades 6-8.

Earth Observing System (EOS) Science Posters. The set includes the following seven posters: Cloud Radiative Effects; Global Ice & Sea Level Changes; Impact of Volcanoes; Vegetation & Hydrology Changes; Ozone Depletion; Ocean Processes; and Greenhouse Effect. Single sets of the posters, for educational purposes, can be ordered on-line at http://eosps0.gsfc.nasa.gov/eos_posters/posters_toc.html (allow six to eight weeks for delivery). The posters may also be previewed at this website.

Planet Earth (WED-119), April 1995. This poster depicts a Geostationary Operational Environmental Satellite

Resources

(GOES)-8 image of the Earth. The back of the poster is divided into five sections including classroom activities concerning saving our planet, atmosphere, land, and oceans.

TOMS Ozone Poster (WAL-144), January 1994. The poster shows measured total ozone levels over the Earth, for each month, from November 1978 to April 1993. The measurements were taken by the Nimbus-7 TOMS instrument. The flip side of the poster contains background information on ozone and classroom activities.

Slide Sets

The following 35mm slide sets are available for purchase from NASA CORE (http://spacelink.nasa.gov/CORE/CORE_Home.html), with noted exceptions. For more information about ordering materials from NASA CORE, please see the section titled NASA Education Resources.

ATLAS 1: Studying Mysteries in the Earth's Atmosphere (CORE #100.0-38), includes 20 slides and activity book for grades 6-8. Describes the first ATLAS mission, which was dedicated to a better understanding of the physics and chemistry of Earth's atmosphere.

Available from NASA CORE: \$8.50, plus \$4.50 shipping within the U.S.
Recommended level: grades 6-8.

Earth/Space Science Slide Set for Educators (CORE #100.0-47), was designed to provide educators with some of the most-recent, space-based observations NASA has obtained in the area of Earth

system science. 122 slides and background information are provided on the following themes that are considered of primary importance to Earth system science research: Clouds and Radiation; Ocean Productivity, Circulation, and Sea-Air Exchange; Greenhouse Gases; Changes in Land Use, Land Cover, Primary Productivity, and the Water Cycle; The Role of the Polar Ice Sheets and Sea Level; Ozone Depletion; and the role of Volcanoes in Climate Change.

The package is available from NASA CORE: \$60, plus \$7.50 shipping within the U.S.; also available online at http://eosps0.gsfc.nasa.gov/eos_edu_pack/toc.html

Recommended level: Grade 9-Adult.

Shuttle Views the Earth - Oceans from Space, Clouds from Space, Geology from Space. These three slide sets include: Oceans - A selection of astronaut photographs of oceanographic features such as spiral eddies, shear zones, island wakes, internal waves, plankton blooms, and algal blooms. Clouds - cloud photographs of jet stream cirrus, squall lines, thunderstorms, land-sea breeze interactions, Von Karman Vortices, and hurricanes taken from the shuttle by astronauts. Geology - photographs of dune fields, atolls, volcanoes, impact craters, drainage patterns, faults, glaciers, and mountain ranges. Each set contains 40 slides and a caption booklet.

Available from: Order Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058-1113; Phone: (281) 486-2172 Fax (281) 486-

2186; \$22 per slide set, \$4.95 shipping for first set, \$1.00 for each additional set.

Recommended level: elementary-adult.

The Ultimate Field Trip - An Astronaut's View of Earth (CORE #100.0-57) is astronaut Kathy Sullivan's account of her observations of the Earth from orbit. Dr. Sullivan writes about the enormous beauty and wonder of the Earth that varies from the regional, e.g., the Great Lakes, the Gulf of Mexico, and the Atlantic coastline; to the amazing detail found in cities, airports, and rivers.

Available online at: <http://eol.jsc.nasa.gov>, or the brochure with 26 slides can be ordered from NASA CORE for \$10.50, plus shipping, plus \$6.00 shipping in the U.S.

Recommended level: elementary-adult.

U.S. Geography: Space Shuttle Slide Sets. Slide sets of Space Shuttle photography for different areas of the United States, including: East Coast States from New England to Florida (CORE #100.0-49; \$10, plus shipping); Appalachian Mountains, Ohio River Valley, and Great Lakes (CORE #100.0-50; \$10, plus shipping); Great Plains States and Mississippi River Valley (CORE #100.0-51; \$10, plus shipping); Rocky Mountains and Southwest States (CORE #100.0-52; \$10, plus shipping); West Coast States, including Alaska and Hawaii (CORE #100.0-53; \$10, plus shipping); and U.S. Cities (CORE #100.0-54; \$26, plus shipping). Each slide set contains a selection of photos taken by astronauts and includes 20 slides with a brief descriptor (with the exception of U.S.

Cities which contains 60 slides.) Available from NASA CORE.

Recommended level: elementary-adult.

Volcanoes of Hawaii and the Planets (CORE #100.0-41), includes 20 slides with descriptions. Compares landforms in Hawaii and on the planets. Prepared by Dr. Peter Mougini-Mark for the Hawaii Space Grant Consortium. Available from NASA CORE: \$8, plus \$6 shipping within the U.S.
Recommended level: high school-adult.

Videotapes

The following are selected videotapes related to MTPE, which are available for purchase from NASA CORE (http://spacelink.nasa.gov/CORE/CORE_Home.html). For more information about ordering materials from NASA CORE, please see the section titled NASA Education Resources.

Blue Planet (CORE #002.2-15V), 1990, was filmed by astronauts from five Space Shuttle missions. This IMAX film dramatically reveals the forces affecting the Earth's ecological balance: volcanoes, hurricanes, earthquakes, and, ultimately, humankind. Length: 42:00; 1/2" VHS—\$30, plus \$6.50 shipping within the U.S.

Recommended level: grade 4-adult.

Glacier Bay, Alaska, From the Ground, Air and Space (CORE #002.2-16V) brings glaciers to life with nine spectacular "fly-bys" of scenic rides over 3-dimensional glaciers, live video footage of ice fronts calving into the sea, and dramatic picture sequences of historical and satellite

data, and shows how a NASA glaciologist has learned about glaciers and how their formation could be related to climate change.

Also available online at: <http://sdc.gsfc.nasa.gov/GLACIER.BAY/glacierbay.story.html> Length: 13:15; 1/2" VHS—\$15.00 plus \$6 shipping within the U.S.

Recommended level: grade 5-adult.

Liftoff to Learning: The Atmosphere Below (CORE #002.2-14V), 1990, illustrates how changes in the Earth's atmosphere are investigated from outer space onboard the Space Shuttle using the ATLAS-1 experiment. Space Shuttle astronauts explain the questions scientists seek to answer by studying the Earth's atmosphere from space. Experiments discussed in this videotape focus on infrared detection of atmospheric remnants from volcanic eruptions, ozone concentration levels, and incoming solar ultraviolet radiation in respect to global warming. Includes a video resource guide for teachers. Length: 16:00; 1/2" VHS—\$15; 3/4" UMATIC—\$25, plus \$6 shipping within the U.S.
Recommended level: grades 5-12.

Mission EarthBound (CORE #099.11 V), 1993/1994, was a series of six interactive videoconferences for teachers of grades 4-8 that was originally broadcast during the 1993/94 school year. This award-winning series included the following 60-minute programs: 1. Preview of the entire Mission EarthBound series; 2. The Earth's Atmosphere-A Cosmic

Perspective (The origin of the Earth, the atmosphere, and life); 3. Atmospheric Ozone-What Is It and What Is Happening to It?; 4. The Climate System and Climate Modeling; 5. Greenhouse Gases and Climate Change; and 6. Challenges and Solutions to Global Atmospheric Change. Length: 6 hours; 1/2" VHS—\$60, plus \$7 shipping within the U.S.

Recommended level: grades 4-8.

SunSplash (Available from NASA CORE in 1998) explains ozone depletion, using computer graphics and animation. The educational narrative explains how ozone in the stratosphere protects us from ultraviolet radiation and demonstrates how chlorofluorocarbons (CFCs) cause destruction of the Earth's protective ozone layer. Length: 7:52.

Recommended level: grades 9-12.

TOPEX/POSEIDON: A Mission to Planet Earth (CORE #002.2-13V), 1992, explains the objectives of the joint U.S./French mission dedicated to studying the circulation of the Earth's oceans. The satellite was launched during 1992 and is vastly improving our understanding of the ocean's role in global climate change, laying the foundation for long-term oceans monitoring from space. Length: 9:00; 1/2" VHS—\$10, plus \$6 shipping within the U.S.

Recommended level: grade 9-adult.

Resources

CD-ROM/Laser Disc

Arctic Observatory/Sea Ice in the Polar Regions was developed by the Consortium for International Earth Science Information Network (CIESIN) through sponsorship by the Office of Naval Research and in cooperation with NASA GSFC. The Arctic Observatory includes a teacher's guide and interactively deals with Arctic phenomena and processes, allowing students to ask and answer questions about interrelationships between several physical aspects of the Arctic system. *Sea Ice in the Polar Regions* is a presentation by NASA GSFC scientist Claire Parkinson, which describes sea ice classification, observation and climate impacts.

Both resources will be available on one CD-ROM from NASA CORE in 1998; they can also be downloaded from: http://www.usra.edu/prog_inst/esse/learnmod.html.

Recommended level: high school-adult.

Earth Observation Images on Laser Videodisc. Over 150,000 astronaut photos of the Earth are currently available on two 12-inch laser videodiscs. These images can be used to enhance Earth science teaching from kindergarten to graduate school. Seen in these photos are volcanic eruptions, transatlantic duststorms, continental-scale smoke palls, deforestation grids in the rain forests of Brazil, the bleeding of Madagascar's red soil out the Betsiboka Estuary, plankton blooms tens of miles long, the rise of the

Great Salt Lake, the fall of the Aral Sea, and the effects of El Niños—from droughts in Australia to floods in California. Disc 1 (CORE #400.0-60) covers the first 44 Space Shuttle missions (1981 - 1991). Disc 2 (CORE #400.0-61) continues with the next 13 missions (1992 - 1993) and, in a few thousand press release images, extends the record back in time from the Space Shuttle in 1993 through Skylab and Apollo and Gemini to Mercury in 1961. Each disc comes with a Guide to Images booklet and IBM-formatted diskettes, containing data records.

Available from NASA CORE, each disc is \$55, plus shipping.

Recommended level: elementary-adult.

Earth Observatorium: Mission to Planet Earth Volumes 1 and 2 (CORE Order #: 400.0-77) These CD-ROMs each contain over 12,000 color photos from two Space Shuttle flights (STS59 and STS-68). Sound, text, and QuickTime movies complement the photographs. The user can view images in time sequence, visit a specific country, or search the disc by keyword, e.g., finding all images with volcanoes, storms, island, etc. Volumes 1 and 2 are available for \$39 each from Rocky Mountain Digital Peeks, P.O. Box 1576, Nederland, CO 80466-1576 USA; (800) 266-7637; <http://www.csn.net/malls/rmdp>. Volume 2 (STS-68) is also available from NASA CORE: \$24, plus \$6 shipping in the U.S.

Recommended level: elementary-adult.

Geomorphology from Space, an out-of-print, 1986 NASA classic publication by Nick Short, Sr. and Robert W. Blair, Jr., is now available on CD-ROM and on the World Wide Web. This publication is designed for use by the remote-sensing science and educational communities to study landforms and landscapes. It contains a gallery of 237 color, and black and white plates of space imagery primarily of the Earth, each treating a geographic region where a particular landform theme is exemplified. Each image is paired with a detailed scientific description of the features in the image, some images are accompanied by line drawings, locator maps, geologic maps, and on-the-ground photographs of the landform.

Available on CD-ROM from NASA CORE in 1998 or online at: http://daac.gsfc.nasa.gov/DAAC_DOCS/daac_ed.html.

Recommended level: high school-adult.

Glacier Power, 1997, CD-ROM, is a curriculum supplement module on the topic of glaciers that was developed in cooperation with NASA by the Alaska Synthetic Aperture Radar Facility (ASF) at the University of Alaska, Fairbanks and in cooperation with the Fairbanks North Star Borough School District and the University of Alaska Fairbanks, School of Education. It has been formatted to be used on the Macintosh by an Internet browser which will enable students in many rural areas who use the CD-ROM to also become acquainted with internet functions as their schools continue progress to come

"on-line." The guide includes information on glaciers and their importance to climate studies; lesson plans; student review exercises, activities, and projects; and resources such as glacier imagery, satellite imagery, illustrations, diagrams, and more. Available online at: <http://www.asf.alaska.edu:2222/> or on CD-ROM from NASA CORE in 1998.

Recommended level: grades 4-6.

Interactive NOVA: Earth. The fourth in a series of *Interactive NOVAs*, the *Earth* videodisk was jointly developed by NASA and the WGBH educational foundation.

Interactive NOVA: Earth focuses on studying the Earth system, beginning with the question, "What makes Earth a good home?" Available from Scholastic Publications, Inc.; preview copies are available for viewing at NASA Educator Resource Centers.

Recommended level: grades 6-8.

Ocean Expeditions: El Niño, was developed by Planet Earth Science through support from NASA. This multimedia learning tool engages students in a journey where they must navigate their own ship, operate modern research tools, and manipulate satellite and climate model data to investigate and help predict El Niño - one of our planet's largest global climactic disruptions. Distributed in 1998 by Tom Snyder Productions (<http://www.teachtsp.com/products/ElNino.html>).

Recommended level: grades 6-12.

Spaceborne Imaging Radar: Seeing the Earth in a New Way (SIR-CED03)

This CD-ROM is based upon radar images generated by the Shuttle Imaging Radar (SIR)-C instrument flown on the Space Shuttle in April and October 1994. The disc contains a teachers' resource guide, presentation materials, lesson guides (including activities for students), radar images, hand-held photographs taken by shuttle astronauts, digitized location and topographic maps, ground photographs, video clips, software for image display and analysis.

Available from NASA CORE: \$12, plus \$6.00 shipping within the U.S., in Macintosh or Windows formats; a companion website is at: <http://southport.jpl.nasa.gov/companion>.

Recommended level: grades 5-12, undergraduate.

General Books/ Brochures

Earth from Above: Using Color-Coded Satellite Images to Examine the Global Environment, 1997, 175 p.,

was written by GSFC scientist Claire Parkinson and is aimed at teaching how to read and interpret satellite images. The book includes 53 satellite images (50 in color), 18 photographs, 9 maps, and 21 schematic diagrams. Questions and answers are included for each chapter. Discussion features such key topics as Antarctic ozone holes, El Niño, deforestation, and the effects of sea ice, snow cover, and volcanoes on climate.

Available for \$21.60 from University Science Books, 55D Gate Five Road, Sausalito, CA 94965 USA; Fax: (415) 332-5393.

Getting to Know Our Ocean

Planet from Space, 1997, is a one-page folded brochure, which highlights the achievements of ocean altimetry science and other applications of TOPEX/Poseidon satellite data.

NASA's Mission to Planet Earth:

Earth Observing System, (PAM-552), provides an overview of the centerpiece of NASA's Earth Science Enterprise: the Earth Observing System. To order copies, please send an e-mail to: hannelore.parrish@gsfc.nasa.gov.

Mission to Planet Earth: A Program to Understand Global Environmental Change, (PAM-556/1-94), 1994,

This brochure provides a general overview of MTPE and is available online at: <http://www.hq.nasa.gov/office/mtpe/mtpetxt.html>.

Revealing our Ocean Planet, 1997, is a 24-page, color brochure, which highlights the achievements of ocean altimetry science and other applications of TOPEX/Poseidon satellite data.

Resources

WWW Sites — K-12 Education

The following K-12 education websites include teaching modules, curriculum, and education resources related to NASA's Earth Science Enterprise.

Aspen Global Change

Institute (AGCI) WWW Server

<http://gcrio.ciesin.org/agci-home.html>

Provides information on AGCI education programs, including excerpts from the "Ground Truth Handbook," *Earth Pulse Notes*, and AGCI summer science sessions.

Classroom of the Future

<http://www.cotf.edu/>

The Classroom of the Future (COTF) Program at Wheeling Jesuit University serves as NASA's premier research and development center for educational technologies and provides technology-based tools and resources to K-12 schools.

Earth Education Site

<http://www.gcrio.org/educ/Earth.html>

This WWW site was developed by the Institute for Global Environmental Strategies (IGES) and the Consortium for International Earth Science Information Network (CIESIN) through the U.S. Global Change Research Information Office. It provides a newsletter and databases that can be searched online to locate educational resources, programs, and events related to Earth system science and global environmental change.

Exploring the Environment

<http://davem2.cotf.edu/ete>

On-line Earth system science course for middle school teachers, developed by NASA's Classroom of the Future

GLOBE Program

<http://globe.fsl.noaa.gov/>

GLOBE students all over the world are taking daily environmental measurements at their schools and sharing their data via the Internet. Some features on this Web site are specially designed and available only to GLOBE teachers and students who are trained in GLOBE measurement procedures. However, most features are available to anyone wanting to learn more about GLOBE, review the scientific areas of GLOBE study, and see the GLOBE student data.

JPL Imaging Radar Home Page

<http://southport.jpl.nasa.gov>

The goals of this site are to: inform the public about NASA and JPL's work in radar remote sensing of the Earth's surface; describe to interested users how they may obtain, use, and analyze radar data and images; provide educational outreach. Includes a companion website to the JPL educational CD-ROM for grades 5-12, "Spaceborne Imaging Radar CD-ROM."

NASA HPCC/IITA K-12 Project

<http://HPCC-K12.gsfc.nasa.gov/>

This site posts lists of useful education WWW pages, including those specifically recommended by teachers in GSFC's various K-12 programs.

Public Use of Remote Sensing Data

<http://rsd.gsfc.nasa.gov/rsd/>

The RSD Program is designed to encourage the development of innovative applications of Earth and space science remote sensing data. This sites provides links to several K-12 education projects, including Athena, Earth System Science Community Curriculum, Passport to Knowledge, Virtually Hawaii, VolcanoWorld, Windows to the Universe, etc.

Understanding the Biosphere from the Top Down: Earth Science

Teacher's Guide for Grades 4-12

http://geo.arc.nasa.gov/sge/jskiles/top-down/intro_product/title-page.html

This Web Site contains a 22-lesson package written by eight local teachers working with the advice and help of Ames Research Center (ARC) personnel in Earth Sciences. The lessons focus on studying the biosphere from space to teach students about the Earth system.

WWW Sites — Research, Data, and Information

The following WWW sites provide background information and resources that may be useful for college-level instruction, lesson plan development, student research projects, and sources of NASA research information and imagery. Many include sections on K-12 education.

Digital Technical Resource Center

<http://sdcd.gsfc.nasa.gov/LIBRARY/digital.trc.contents.html>

The Digital Technical Resource Center provides on-line electronic resources for people involved in or wanting to learn more about the Earth, space, and computational sciences. Included are free, on-line journals and magazines, graphics, technical links, and reference materials, such as dictionaries, libraries, and links to universities and Federal agencies.

Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAAC)

EOSDIS will include data from NASA's EOS spacecraft, airborne and ground-based instruments, and existing data sets. EOSDIS DAACs are responsible for distributing EOS-related data, their WWW sites also have education sections.

■ **Alaska SAR Facility**

<http://www.asf.alaska.edu/>

Disciplines: Sea ice, polar processor imagery, synthetic aperture radar (SAR)

■ **EROS Data Center (EDC) Land Processes Distributed Active Archive Center (DAAC)**

<http://edcwww.cr.usgs.gov/landdaac/>

Disciplines: Land processes

■ **Goddard Space Flight Center (GSFC) DAAC**

<http://daac.gsfc.nasa.gov>

Disciplines: Upper atmosphere, atmospheric dynamics, global biosphere, geophysics.

■ **Langley Research Center (LARC) DAAC**

<http://eosweb.larc.nasa.gov>

Disciplines: Radiation budget, clouds, aerosols, tropospheric chemistry. Section on education.

■ **National Snow and Ice Data Center (NSIDC)**

<http://eosims.colorado.edu:1733>

Disciplines: Snow and ice, cryosphere and climate

■ **Physical Oceanography Distributed Active Archive Center (DAAC)**

<http://podaac.jpl.nasa.gov/>

Disciplines: Ocean circulation and air-sea interaction

■ **Oak Ridge National Laboratory (ORNL) DAAC— Educators Corner**

<http://www-eosdis.ornl.gov/>

Disciplines: Biogeochemical Dynamics

■ **Socio-Economic Data and Applications Center (SEDAC)**

<http://sedac.ciesin.org>

Disciplines: Socio-economic data related to global change.

EOS Project Science Office

<http://eospsa.gsfc.nasa.gov>

The EOS Project Science Office produces a WWW site which allows the user to discover, retrieve, and display EOS and Earth science resources, including documents and reports, calendar of events, images, slides, fact sheets, posters, CD-ROMs, etc.

Earth Science Home Page — Johnson Space Center

<http://eol.jsc.nasa.gov>

The Earth Science home page provides access to the database of the Space Shuttle Earth Observations Project (SSEOP) containing records of the location and description of over 250,000 of the astronaut photographs of the Earth. Other features include "Ask Our Earth Scientist a Question," image highlights from shuttle missions and from the Shuttle/Mir missions. Internet guests may also view Space Shuttle orbit track maps and calculate shuttle positions when specific times are entered into the program.

Education Resources for Oceanography

<http://podaac.jpl.nasa.gov/edudoc.html>

A 25-page online document of resources on oceanography and Earth Sciences, appropriate for elementary through undergraduate education.

El Niño Web Site

<http://nsipp.gsfc.nasa.gov/enso>

The NASA Seasonal to Interannual Prediction Project (NSIPP), which is part of the Laboratory for Hydrospheric Processes at NASA GSFC, has produced an

Resources

El Niño web site. This site includes a nine-page El Niño-Southern Oscillation (ENSO) primer, appropriate for general audiences, which presents background information, graphics, data and images, and audio, on this timely topic.

Geomorphology from Space

http://daac.gsfc.nasa.gov/DAAC_DOCS/geomorphology/GEO_HOME_PAGE.html

WWW version of an out-of-print 1986 NASA publication. This resource is a study of landforms and landscapes, including the description, classification, origin, development, and history of planetary surfaces. The core of the book is a gallery of space imagery consisting of 237 plates, each treating some geographic region where a particular landform theme is exemplified. Commentary, photographs, locator maps, and sometimes a geologic map accompany each plate.

GSFC Applied Information Science Web pages

<http://crunchy.gsfc.nasa.gov>

GSFC's Applied Information Science Branch develops creative information technologies for Earth and space sciences. WWW site includes tools and information on topics such as: remote sensing, endangered species tracking, scientific visualization, weather data, and direct readout.

JPL's El Niño Watch

<http://www.jpl.nasa.gov/elnino>

Presents the latest images and press releases based on observations of the El

Niño phenomenon by the US/French TOPEX/Poseidon satellite and other JPL satellites and instruments.

Landsat Images WWW Site

<http://www.jsu.edu/depart/geography/nasa/index.html>

Educational web site, developed by Jacksonville State University under a NASA EPSCoR Program grant. The site includes Landsat imagery for the Southeastern United States and includes a section on image interpretation.

NASA Earth Science Enterprise Home Page

<http://www.bq.nasa.gov/office/mtpe>

An excellent starting point for learning about NASA's Earth Science Enterprise, this home page provides information on topics such as: Missions (satellites, instruments, and experiments); Science of the Earth system; Access to data (links to data and imagery sources); Publications and education programs (descriptions of education programs and full text of many publications). Many links to other information resources are also included.

Oceanography from the Space Shuttle

http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/OCDST/shuttle_oceanography_web_oss_cover.html

A pictorial survey of oceanic phenomenon visible to the naked eye from space. Originally published in 1989 by the Naval Research Lab, it is now out of print and only available on this web site.

Remote Sensing Tutorial

<http://code935.gsfc.nasa.gov/Tutorial/TofC/Coverpage.html>

The primary purpose of this Web Site Tutorial, is to inform both professionals and the general public about the principles and the achievements of remote sensing and to point to the anticipated functions and benefits of NASA initiatives. It is also intended to be a resource for college students and others wishing to learn the basics of space-based remote sensing.

SeaWiFS Project

<http://seawifs.gsfc.nasa.gov/SEAWIFS.html>

The SeaWiFS instrument will study the carbon cycle by observing the world's oceans from space and measuring ocean color. This site includes descriptive information about the project, a teachers' guide, and will provide access to SeaWiFS data and imagery.

TOMS Ozone Home Page

<http://jwocky.gsfc.nasa.gov>

This page is the home for information, data, and images for all of the Total Ozone Mapping Spectrometer (TOMS) instruments. NASA's TOMS instruments provide global measurements of total column ozone on a daily basis.

**U.S. Global Change Research
Information Office (GCRIO)**

<http://www.gcrio.org>

The U.S. GCRIO, in support of the U.S. Global Change Research Program, is a resource service for access to information and data concerning the prevention, mitigation, and adaptation to the effects of global environmental change. The WWW site contains several USGCRP documents and an "Education and Funding Resources" section.

**U.S. Global Change Research
Program (USGCRP) WWW site**

<http://www.usgcrp.gov/>

Home page of the US Global Change Research Program — a multi-agency effort studying global environmental changes. This site provides information on research programs, publications, and links to education programs and resources.

Weather Imagery

<http://climate.gsfc.nasa.gov/~chesters/goesproject.html>

Includes the latest Geostationary Operational Environmental Satellite (GOES) weather satellite imagery, QuickTime moves, and information about the satellites. Includes sections with GOES images that show hurricanes and volcanoes.

**NASA-Wide
Education Resources**

**NASA Online
Resources**

<http://www.hq.nasa.gov/education>

NASA on line resources for educators provide current educational information and instructional resource materials to teachers, faculty, and students. A wide range of information is available, including science, mathematics, engineering, and technology education lesson plans, historical information related to the aeronautics and space program, current status reports on NASA projects, news releases, information on NASA educational programs, useful software and graphics files. Educators and students can also use NASA resources as learning tools to explore the Internet, accessing information about educational grants, interacting with other schools that are already on-line, and participating in online interactive projects, communicating with NASA scientists, engineers, and other team members to experience the excitement of real NASA projects.

NASA Spacelink

<http://spacelink.nasa.gov>

NASA Spacelink is an electronic resource specifically developed for use by the educational community. This comprehensive electronic library contains current and historical information related to NASA's aeronautics and space research. Teachers, faculty, and students will find that Spacelink

offers not only information about NASA programs and projects, but also teacher guides with activities, images, and computer software that can enhance classroom instruction.

Spacelink also provides links to other NASA resources on the Internet. Educators can access materials chosen specifically for their educational value and relevance, including science, mathematics, engineering, and technology education lesson plans, information on NASA educational programs and services, current status reports on Agency projects and events, news releases, and television broadcast schedules for NASA Television.

FEDIX

<http://www.rams-fie.com>

Gopher: fedix.fie.com or
192.111.228.33

Telnet: fedix.fie.com or 192.111.228.33

Modem line: (301) 258-0953; (800) 783-3349, Data format: 8-N-1

FEDIX data bases provide on-line information on Federal research and educational opportunities, program contacts, scholarships, research equipment, and minority opportunities. An electronic mail feature allows users to communicate with the system operators. The FEDIX system: Provides access at no cost, is easy to use, and has no registration fees; Offers a comprehensive source for participating agencies' research and educational opportunities; Provides the latest information on participating agencies and minority institutions; Updates daily information available from the *Commerce Business Daily Federal Register*.

Resources

Any microcomputer or terminal with communications software and a modem operating at 1200, 2400, 9600, or 14,4000 baud, or any computer that has access to Internet can connect to the system. A free user guide is available by calling: (301) 975-0103, or (800) 875-2562.

Quest

<http://quest.arc.nasa.gov>

Quest is the home of NASA's K-12 Internet Initiative, an electronic resource that the Agency has developed for the educational community. The project specializes in providing programs, materials, and opportunities for teachers and students to use NASA resources as learning tools to explore the Internet. Through Quest, teachers can access information about educational grants, interact with other schools which are already online, and explore "links" to other NASA educational resources.

One of Quest's most unique endeavors is the "Sharing NASA" online interactive project. Students and teachers are given the opportunity to communicate with NASA scientists and researchers to experience the excitement of real science in real time. In addition to these programs, the project also houses information about and materials which accompany the K-12 Internet Initiative videos. These videos promote the Internet in schools and assist educators in acquiring and integrating the Internet into the classroom.

For information about the videotapes, send an e-mail message to: video-info@quest.arc.nasa.gov.

NASA Television (NTV)

<http://www.hq.nasa.gov/ntv.html>

<http://spacelink.nasa.gov/NASA.News/>
(Select "TV Schedules")

<http://www.nasa.gov/> (Select "Today at NASA" and "What's New on NASA TV?")

NTV features Space Shuttle mission coverage, live special events, interactive education videoconferences, electronic field trips, aviation and space news, and historical NASA footage. Regular NTV programming includes a Video (News) File from noon to 1:00 pm, a NASA Gallery File from 1:00 to 2:00 pm, and an Education File from 2:00 to 3:00 pm (all times Eastern). This sequence is repeated at 3:00 pm, 6:00 pm, and 9:00 pm, Monday through Friday. The NTV Education File features programming for Educators and students on science, mathematics, and technology. NTV is transmitted on GE-2, transponder 9C, at 85 degrees West longitude, vertical polarization, with a frequency of 3880 megahertz, and audio of 6.8 megahertz; or through collaborating distance learning networks and local cable providers. Educators are welcome to videotape from NTV for later use. Live feeds preempt regularly scheduled programming. For more information on NTV contact: NASA TV, NASA Headquarters, Code P-2, Washington, DC 20546-0001 USA; Phone: (202) 358-3572.

NASA's Central Operation of Resources for Educators (CORE)

<http://spacelink.nasa.gov/CORE>

CORE is a worldwide distribution center for NASA's audiovisual educational materials. For a minimal fee, NASA CORE will provide nonprofit educators with materials through its mail order service. Educational materials available include videotape programs, slide sets, computer software, CD-ROMs, and laser discs. These materials are designed to increase awareness and understanding of NASA's scientific research and technology and provide a historical account of NASA's accomplishments.

NASA CORE is a nonprofit organization jointly sponsored by the National Aeronautics and Space Administration and the Lorain County Joint Vocational School in Oberlin, Ohio. Orders are processed for a small fee that includes the cost of the media. Educators may request a catalog and order form by writing, calling, faxing, or e-mailing: NASA CORE, Lorain County JVS, 15181 Route 58 South, Oberlin, OH 44074 USA; Phone: (440) 774-1051, ext. 249 / 293; Fax: (440) 774-2144; E-mail: nasaco@lecca.esu.k12.oh.us.

NASA Educator Resource Center Network (ERCN)

Through the NASA Educator Resource Center Network (ERCN), NASA provides expertise and facilities to help educators

NASA Center ERCs

If you live in: Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming

NASA Ames Research Center
Educator Resource Center
Mail Stop 253-2
Moffett Field, CA 94035-1000
Phone: (650) 604-3574
Fax: (650) 604-3445

If you live in: California (Mainly cities near Dryden Flight Research Facility)

NASA Dryden Educator Resource Center
45108 North 3rd Street East
Lancaster, CA 93535
Phone: (805) 948-7347
Fax: (805) 948-7068

If you live in: California (Mainly cities near Vandenberg AFB)

Mr. Edmond Burke
Maple High School
Vandenberg Air Force Base
One Carob Street
NASA Educator Resource Center
Lompac, CA 93437
Phone: (805) 735-5131

If you live in: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont

NASA Goddard Space Flight Center
Educator Resource Center
Mail Code 130.3
Greenbelt, MD 20771-0001
Phone: (301) 286-8570
Fax: (301) 286-1781

If you live in: Virginia's and Maryland's Eastern Shores

GSFC/Wallops Flight Facility
Visitor Center
NASA Educator Resource Center
Bldg. J-17
Wallops Island, VA 23337
Phone: (757) 824-2298
Fax: (757) 824-1776

If you live in: California, US States and Territories*

NASA Jet Propulsion Laboratory
Educator Resource Center
4800 Oak Grove Drive
Mail Code CS-530
Pasadena, CA 91109-8099
Phone: (805) 948-7347
Fax: (805) 948-7068

**solar system and planetary exploration inquiries are handled.*

If you live in: Florida, Georgia, Puerto Rico, Virgin Islands

NASA John F. Kennedy Space Center
Educator Resource Center
Mail Code ERC
Kennedy Space Center, FL 32899-0001
Phone: (407) 867-4090
Fax: (407) 867-7242

If you live in: Colorado, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas

NASA Johnson Space Center
Educator Resource Center
1601 NASA Road 1
Houston, TX 77058-3696
Mail Code AP2
Phone: (281) 483-8676
Fax: (281) 483-9638

If you live in: Kentucky, North Carolina, South Carolina, Virginia, West Virginia

NASA Educator Resource Center
Virginia Air and Space Center
Hampton Roads History Center
600 Settler's Landing Road
Hampton, VA 23669-4033
Phone: (757) 727-0900 ext. 757
Fax: (757) 727-0898

If you live in: Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin

NASA Lewis Research Center
Educator Resource Center
Mail Stop 8-1
21000 Brookpark Road
Cleveland, OH 44135-3191
Phone: (216) 433-2017
Fax: (216) 433-3601

If you live in: Mississippi

NASA Stennis Space Center
Educator Resource Center
Building 1200
Stennis Space Center, MS 39529-6000
Phone: (601) 688-3337
Fax: (601) 688-2824

If you live in: Alabama, Arkansas, Iowa, Louisiana, Missouri, Tennessee

U. S. Space & Rocket Center
NASA Marshall Educator Resource Center
One Tranquility Base
Huntsville, AL 35758
Phone: (205) 544-5812
Fax: (205) 544-5820

access and utilize science, mathematics, and technology instructional products aligned with national standards and appropriate state frameworks and based on NASA's unique mission and results. ERCs partner with local, state, and regional educational organizations to become part of the systemic initiatives in the state.

The ERCN is designed so that educators have the opportunity to receive demonstrations of and utilize educational technologies such as NASA Spacelink, NASA Television, and the NASA Education Home Page. ERCs also provide inservice and preservice training utilizing NASA instructional products. Educators have the opportunity to preview, copy, and/or receive NASA instructional products.

ERCs are located on or near NASA Field Centers as well as at planetariums, museum, colleges, universities, and other non-profit organizations around the United States. A list of the ERCs located at NASA Field Centers, as well as information on the geographical region served by each Field Center is provided, followed by a list of the rest of the ERCN.

State ERCs

Alabama

Tri-State Learning Center
NASA Regional Educator Resource Center
P. O. Box 508
Iuka, MS 38852-0508
Phone: (601) 423-7455

Alaska

Alaska Science Center
NASA Regional Educator Resource Center
Alaska Pacific University
4101 University Drive
Anchorage, AK 99508
Phone: (907) 564-8207

Arizona

University of Arizona
Lunar and Planetary Lab
NASA Regional Educator Resource Center
1629 E. University Blvd.
Tucson, AZ 85721-0092
Phone: (520) 621-6947
Fax: (520) 621-4933

Arkansas

University of Arkansas-Little Rock
NASA Regional Educator Resource Center
Star Project-Planetarium
2801 South University/FH 215
Little Rock, AR 72204
Phone: (501) 569-3259
Fax: (501) 569-3314

California

California Museum of Science and Industry
700 State Drive
Los Angeles CA 90037
Phone: (213) 744-7418
Fax: (213) 744-7427

California State University, Fresno
NASA Regional Educator Resource Center
Mailstop 01
5005 N. Maple Avenue
Fresno, CA 93740-8025
Phone: (209) 278-0355

Colorado

U.S. Space Foundation
NASA Regional Educator Resource Center
2860 S. Circle Drive, Suite 2301
Colorado Springs, CO 80906-4184
Phone: (719) 576-8000
Fax: (719) 576-8801

Connecticut

Aerospace and Environmental
Education Resource Center
Media Building, Room 135
Eastern Connecticut State College
83 Windham Street
Willimantic, CT 06226-2295
Phone: (860) 465-5725
Fax: (860) 465-4338

Delaware

Delaware Aerospace Center
NASA Regional Educator Resource Center
500 C Duncan Road
Wilmington, DE 19809-2359
Phone: (302) 761-7494
Fax: (302) 834-1369

District of Columbia, US States and Territories*

National Air and Space Museum
Smithsonian Institution
Educator Resource Center, MRC-305
Washington, DC 20560
Phone: (202) 357-4223
Fax: (202) 633-8928

*Air and space exploration inquiries are handled.

University of the District of Columbia
NASA Regional Educator Resource Center
Mail Stop 4201, 4200 Connecticut Ave. N.W.
Washington, DC 20008
Phone: (202) 274-6287
Fax: (202) 274-5094

Georgia

Southern Polytechnic State University/GYSTC
NASA Regional Educator Resource Center
1100 S. Marietta Parkway
Marietta, GA 30060-2896
Phone: (770) 528-6272
Fax: (770) 528-4980

Hawaii

State Department of Education
Barbers Point Elementary School
NASA Regional Educator Resource Center
3001 Boxer Road
Barbers Point Naval Air Station
Kapolei, HI 96707-2103
Phone: (808) 673-7410
Fax: (808) 682-3924

Idaho

University of Idaho at Moscow
College of Education
NASA Regional Educator Resource Center
Moscow, ID 83844-3080
Phone: (208) 885-6030
Fax: (208) 885-7607

Illinois

Chicago Museum of Science and Industry
NASA Regional Educator Resource Center
57th Street and Lakeshore Drive
Chicago, IL 60637-2093
Phone: (773) 684-1414 x 2426
Fax: (773) 684-5580

Indiana

Science Central
1950 North Clinton Street
Fort Wayne IN 46805
Phone: (219) 424-2400, ext. 416
Fax: (219) 422-2899

University of Evansville
NASA Regional Educator Resource Center
Bossier Parish Community College
NASA Regional Educator Resource Center
2719 Airline Drive
Bossier City, LA 71111
Phone: (318) 746-9851, ext 319

Massachusetts

Bridgewater State College
NASA Regional Educator Resource Center
Media Service, Maxwell Library
Bridgewater, MA 02325
Phone: (508) 697-1248 ext. 2022
Fax: (508) 697-1729

Michigan

Central Michigan University
NASA Regional Educator Resource Center
Ronan Hall, Room 101
Mount Pleasant, MI 48859
Phone: (517) 774-4387
Fax: (517) 774-4374

Northern Michigan University
The Glenn T. Seaborg Center
NASA Regional Educator Resource Center
1401 Presque Isle
Marquette, MI 49855-5394
Phone: (906) 227-2002
Fax: (906) 227-2013

Oakland Schools Science,
Mathematics & Technology Center
1480 Scott Lake Road
Waterford, MI 48328
Phone: (248) 683-7476
Fax: (248) 683-9438

Minnesota

Mankato State University
NASA Regional Educator Resource Center
MSC Box 52 Armstrong Hall
Mankato, MN 56002-8400
Phone: (507) 389-5277
Fax: (507) 389-5853

St. Cloud State University
Center for Information Media
NASA Regional Educator Resource Center
720 Fourth Ave. South/CH-29
St. Cloud, MN 56301-4498
Phone: (320) 255-2062
Fax: (320) 255-4478

Mississippi

Choctaw Teacher Enhancement Center
Route 7, Box 72
Philadelphia, MS 39350
Phone: (601) 650-9320
Fax: (601) 650-9638

Mississippi Delta Community College
NASA Regional Educator Resource Center
P.O. Box 668 Highway #3
Moorehead, MS 38761
Phone: (601) 246-6385
Fax: (601) 246-8627

NASA Tri-State Education Initiative
c/o Tishomingo High School
Highway 72 West
NASA Regional Educator Resource Center
Iuka, MS 38852
Phone: (601) 423-7454
Fax: (601) 423-7458

Montana

Western Montana College of the U. of MT
 NASA Regional Educator Resource Center
 710 S. Atlantic Street
 Carson Library
 Dillon, MT 59725
 Phone: (406) 683-7492
 Fax: (406) 683-7493

Nebraska

University of Nebraska State Museum
 NASA Regional Educator Resource Center
 14th & U Streets, 135 Morrill Hall
 Lincoln, NE 68588-0374
 Phone: (402) 472-4525
 Fax: (402) 472-8899

University of Nebraska at Omaha
 NASA Regional Educator Resource Center
 Mallory Kountze Planetarium
 Durham Science Center, Room 144
 60th and Dodge Street
 Omaha, NE 68182-0266
 Phone: (800) 553-6272
 Fax: (402) 554-3100

Nevada

Community College of Southern Nevada
 NASA/Nevada Regional Educator Resource Center - C2A
 Educator Resource Center, Room 2100F
 3200 E. Cheyenne Ave.
 North Las Vegas, NV 89129
 Phone: (702) 651-4505
 Fax: (702) 643-8103

New Jersey

Georgian Court College
 NASA Regional Educator Resource Center
 900 Lakewood Avenue
 Lakewood, NJ 08701-2697
 Phone: (732) 364-2200, ext 419
 Fax: (732) 364-2215

New Mexico

Cooperative Educational Services
 4216 Balloon Park Road, NE
 Albuquerque, NM 87109
 Phone: (505) 344-5470
 Fax: (505) 344-9343

New Mexico State University
 NASA Regional Educator Resource Center
 Wells Hall, Bay 4, Box 30001, Dept. SG
 Las Cruces, NM 88003-0001
 Phone: (505) 646-6414
 Fax: (505) 646-7791

New York

The City College
 NASA Regional Educator Resource Center
 Harris Hall, Room 109
 nvent Avenue at 138th Street
 New York, NY 10031
 Phone: (212) 650-6993
 Fax: (212) 650-5546

North Carolina

University of North Carolina - Charlotte
 NASA Regional Educator Resource Center
 J. Murrey Atkins Library
 Charlotte, NC 28223
 Phone: (704) 547-2559
 Fax: (704) 547-3579

North Dakota

University of North Dakota
 NASA Regional Educator Resource Center
 Center for Aerospace Science
 P.O. Box 9008, University Station
 Grand Forks, ND 58202-9008
 Phone: (701) 777-4856
 Fax: (701) 777-3711

Ohio

Eisenhower National Clearinghouse
 1929 Kenny Road
 Columbus, OH 43210-1079
 Phone: (614) 292-8389
 Fax: (614) 292-2066

University of Cincinnati
 NASA Regional Educator Resource Center
 Curriculum Resources Center Library
 Mail Location 0219, 600 Blegen Library
 Cincinnati, OH 45221-0219
 Phone: (513) 556-1430
 Fax: (513) 556-2113

Oklahoma

Oklahoma State University
 NASA Aerospace Education Resource Center
 308A CITD Building
 Stillwater, OK 74078-8089
 Phone: (405) 744-6784
 Fax: (405) 744-6785

Oregon

Oregon Museum of Science and Industry
 NASA Regional Educator Resource Center
 1945 S.E. Water Avenue
 Portland, OR 97214-3354
 Phone: (503) 797-4551
 Fax: (503) 797-4500

Pennsylvania

University of Pittsburgh
 Computer Curriculum Information Center
 NASA Regional Educator Resource Center
 4H17 Forbes Quad, 230 S. Boquet St.
 Pittsburgh, PA 15260-0000
 Phone: (412) 648-7558

Puerto Rico

University of Puerto Rico at Mayaguez
 Resource Center for Science & Engineering
 Physics Building Office #200
 Mayaguez, PR 00681
 Phone: (787) 831-1022 or 831-1025
 Fax: (787) 832-4680

Rhode Island

Rhode Island College
 NASA Regional Educator Resource Center
 Henry Barnard School, RIC, 600 Mt. Pleasant Avenue
 Providence, RI 02908
 Phone: (401) 456-8001
 Fax: (401) 456-8128

South Carolina

Stanback Planetarium
 NASA Regional Educator Resource Center
 South Carolina State University
 300 College Street/P.O. Box 7636
 Orangeburg, SC 29117-7636
 Phone: (803) 536-8709
 Fax: (803) 533-3726

South Dakota

NASA Regional Educator Resource Center
 T. I. E. Office, 1925 Plaza Blvd.
 Rapid City, SD 57701
 Phone: (605) 394-1876
 Fax: (605) 394-5315

Tennessee

Tri-State Learning Center
 NASA Regional Educator Resource Center
 P. O. Box 508
 Iuka, MS 38852-0508
 Phone: (601) 423-7455

University of Tennessee at Martin
 NASA Regional Educator Resource Center
 Center for Excellence in Mathematics and Science
 217 Gooch Hall
 Martin, TN 38238-5029
 Phone: (901) 587-7191/7166
 Fax: (901) 587-7205

Texas

University of Texas at Brownsville
 NASA Regional Educator Resource Center
 80 Fort Brown
 Brownsville, TX 78520
 Phone: (210) 982-0295
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Utah

Utah State University
 College of Education
 NASA Regional Educator Resource Center
 170 Education Building
 Logan, Utah 84322-2845
 Phone: (801) 797-3377
 Fax: (801) 797-3939

Weber State University
 NASA Regional Educator Resource Center LL230
 2509 University Circle
 Ogden, UT 84408-2905
 Phone: (801) 626-6590
 Fax: (801) 626-7257

Vermont

Vermont College of Norwich University
 NASA Regional Educator Resource Center
 Schulmaier Hall
 Montpelier, VT 05602
 Phone: (802) 828-8845

Virginia

Radford University
 NASA Regional Educator Resource Center
 Tyler Avenue/Walker Hall
 Norwood Street/Box 6999
 Radford, VA 24142
 Phone: (703) 831-6284
 Fax: (703) 831-5807

Washington

University of Washington
NASA Regional Educator Resource Center
Space Grant Programs
352 Johnson Hall, Box 351650
Seattle, WA 98195
Phone: (206) 543-1943

West Virginia

NASA Fairmont IVV
100 University Drive, Fairmont, WV 26554
Phone: (304) 367-8216
Fax: (304) 367-8203

University of Charleston
125 Riggelman Hall
2300 MacCorkle Avenue, SE
Charleston, WV 25304
Phone: (304) 357-4773
Fax: (304) 357-4715

Wheeling Jesuit College
NASA Regional Educator Resource Center
316 Washington Avenue
Wheeling, WV 26003-0000
Phone: (304) 243-2401
Fax: (304) 243-2497

Wisconsin

University of Wisconsin at LaCrosse
NASA Regional Educator Resource Center/NASA Room
1725 State Street, Murphy Library Room 270
LaCrosse, WI 54601
Phone: (608) 785-8148

Wyoming

University of Wyoming
NASA Regional Educator Resource Center
Learning Resource Center
Education Building, Room 222
Laramie, WY 82070
Phone: (307) 766-2527

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Kennedy Space Center, FL 32899-0001
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John C. Stennis Space Center
Stennis Space Center, MS 39529
Phone: (601) 688-3830

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Acknowledgments

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Cover Design:

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(SVS), NASA GSFC/Raytheon STX

Document Design:

AnneMarie Welsh, Welsh Design

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Front Cover:

Front Earth -- Sea-viewing Wide Field-of-view
Sensor (SeaWiFS) Biosphere View of the World.
This true color image shows a global composite
of data from an average of September 4 through
December 31, 1997. The red colors show high
concentrations of chlorophyll in the water, the
yellows/greens indicate intermediate concentra-
tions of chlorophyll and the blues/purples show
low concentrations of chlorophyll. The black
areas indicate there is no data. SeaWiFS data
will allow routine assessment of global
vegetation patterns, both land and ocean,
needed to understand the world's ecosystems
and global change. Data supplied by the
SeaWiFS Project. Image by Alex Kekesi and
Barbara Summey, SVS

Middle Earth -- Sea Surface Temperature. The
temperature of water at the surface of the
oceans is measured by satellites every 3 hours,
every day. Temperatures are usually between 1
and 20 degrees C. A wide range of colors is
used to emphasize the subtle variations in
temperature. In this image, orange and red
colors represent warmer waters, while green
and blue colors represent the colder areas.
This sea surface data was obtained through the
NOAA/TIROS Operational Meteorological
Satellites (NOAA-7, -9, and -11). The data was
provided by the National Oceanic and Atmo-
spheric Administration (NOAA). This animation
sequence is a composite view of the Earth in
infrared radiation with clouds removed. Data
supplied by William Rossow of the GIS Global
Processing Center for ISCCP. Image created by
Barbara Summey, SVS

Back Earth -- SeaWiFS true color image
collected September 18-25, 1997. This Earth
shows the smoke plumes caused by fires in
Indonesia.

SeaWiFS Data supplied by the SeaWiFS Project.
Image created by Alex Kekesi, SVS.

SeaWiFS launch date: August 1, 1997
Investigator: SeaWiFS Office,
Earth Sciences Directorate, Global Change Data
Center Division, Goddard Space Flight Center
<http://seawifs.gsfc.nasa.gov/SEAWIFS.html>

Children's Picture -- Photo provided by John
Katzenberger, Aspen Global Change Institute

Back Cover:

Top Image -- Earth Observing System (EOS) AM
Launch date: June 1998
EOS AM Project Scientist: Dr. Yoram Kaufman,
Laboratory for Atmospheres Division, Climate
and Radiation Branch, Goddard Space Flight
Center
<http://modarch.gsfc.nasa.gov/EOS-AM>

This picture illustrates EOS AM orbiting the
Earth while the Moderate-Resolution Imaging
Spectroradiometer (MODIS) instrument
collects sea surface temperature and vegetation
data. Model created by Ed Russell, SVS. Earth
map layers provided by Barbara Summey, SVS.

The EOS AM science objectives are to begin the
continuous, long-term, calibrated measure-
ments of global parameters and processes to
improve understanding of the following: the
role of clouds and aerosols in Earth radiation
budget; the causes and consequences of
changes in levels of tropospheric ozone and

temperature, ocean primary productivity,
tropospheric carbon monoxide and methane
concentrations, variations in areal extent of
snow and ice, volcanic effects; fire occurrences,
and surface topography.

Bottom Image -- Tropical Rainfall Measuring
Mission (TRMM)

Launch date: November 27, 1997 from
Tanegashima Space Center at 4:27 PM EST
Investigator: Dr. Christian Kummerow,
Laboratory for Atmospheres Division, Mesoscale
Atmospheric Processes Branch, Goddard Space
Flight Center
<http://trmm.gsfc.nasa.gov>

This picture simulates TRMM revealing the
internal structure of storms. Prior to TRMM, we
could only get such information after the storms
-- a mature hurricane in this example -- made
landfall. This information will help us to better
understand and predict storm systems as they
form and intensify over open ocean regions.
Model created by Greg Shirah, SVS.

TRMM is a joint mission between NASA and the
National Space Development Agency (NASDA) of
Japan designed to measure tropical rainfall and
give us new information on the hydrological
cycle. TRMM will also increase our understand-
ing of the climate system and the tropical
radiation budget. TRMM will begin the process
of understanding the interactions between water
vapor, clouds and precipitation which are
central to regulating the climate system.

This catalog can be downloaded from the NASA
Earth Science Enterprise WWW site at:

<http://www.hq.nasa.gov/office/mtpe/education/>



